The Welding Engineer

Reg. U. S. Pat. Office

Founded by L. B. Mackenzie, 1916

DECEMBER, 1929 VOL. 14, NO. 12

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A PROJECTION WELDING APPLICATION AT THE NILES STEEL PRODUCTS CO., NILES, OHIO

A Resistance Welding Job Made Practical

With *ELKONITE* Dies!

THE application shown here consists of projection welding 3 brackets to a truck running board. Both the brackets and the running board are 16 gauge steel—requiring extra care to obtain a satisfactory weld.

Copper electrodes formerly used on this job had to be redressed so often (every 2 hours) that they finally equipped the welding machine with *ELKONITE*. At the time of the last report these *ELKONITE* electrodes had been making excellent welds for 4 weeks and were still operating. In the illustration above, the upper set of electrodes may be seen above the running board which is in position for the weld.

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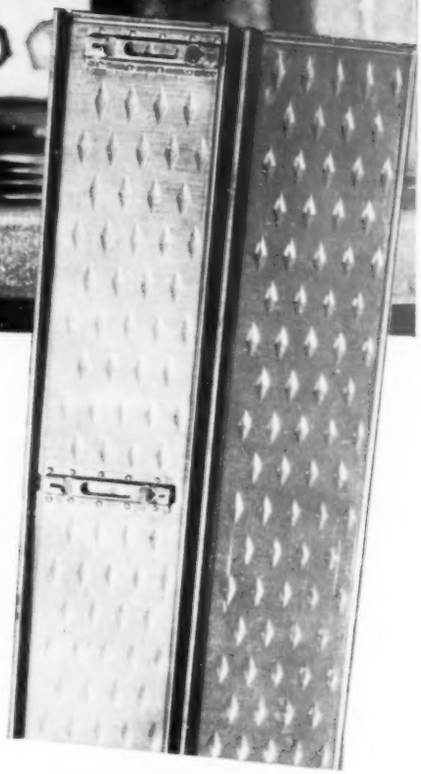
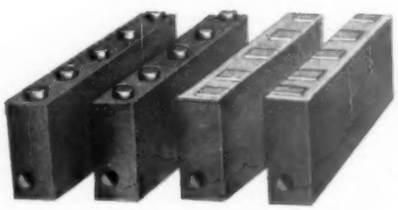


(Above) Section of the running board before and after welding the brackets. Both parts are 16 gauge steel—requiring reliable electrodes to make a good weld.

(Below) The *ELKONITE* electrodes used on this job. The Elkonite may be seen on the top portion of each electrode.



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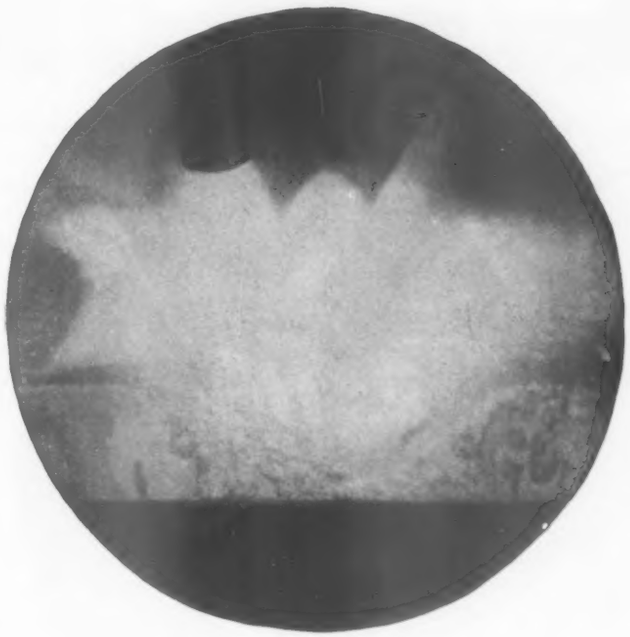

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The Welding Engineer

Founded by L. B. Mackenzie, 1916

Volume 14 | December, 1929 | Number 12

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The Welding Engineer does not publish in its news or advertising columns any matter that deals with or refers to either personal or legal controversies.

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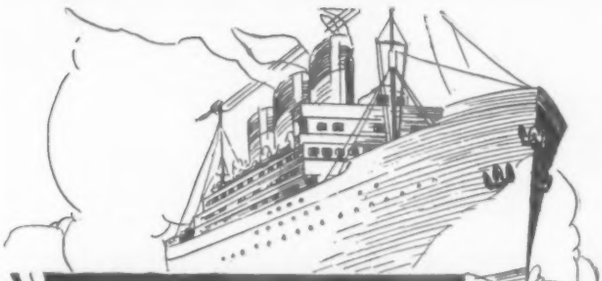

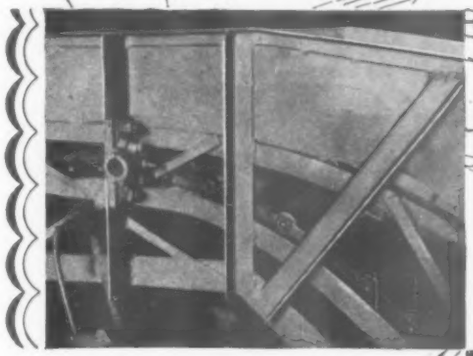

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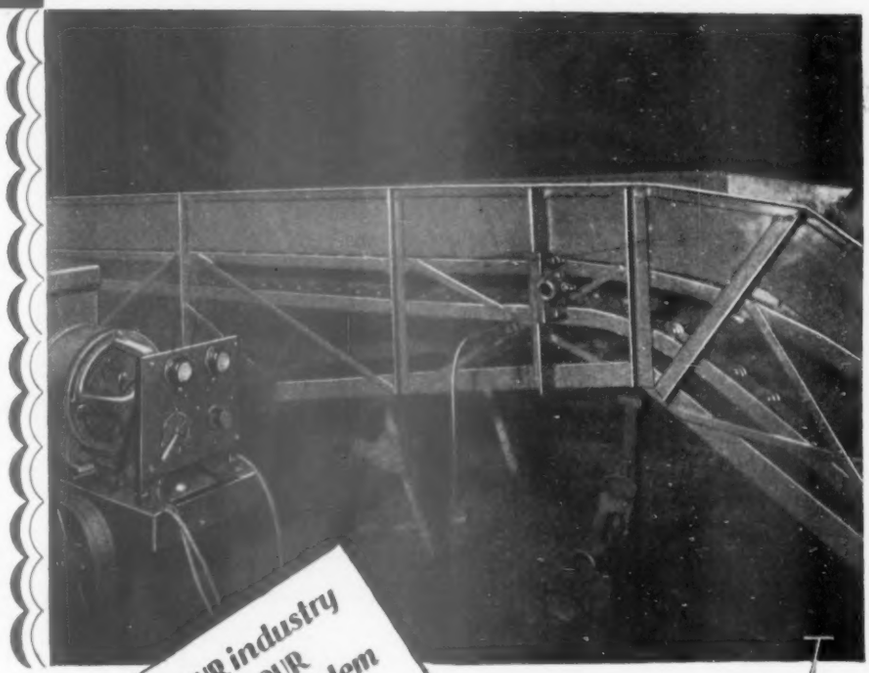

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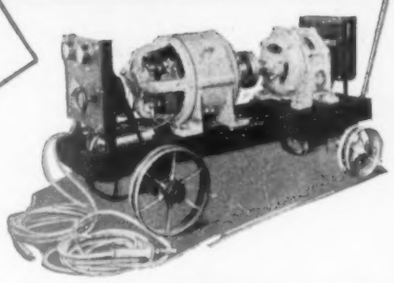

The Wilson Model S Welding Machine shown above is the Type 200 Amperes, one-operator, electric-motor-driven outfit.

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See "Electric Resistance Welders"

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See "Electric Resistance Welders"

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International Oxygen Co.
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St. Paul Welding & Mfg. Co.
Stoody Company
Torchweld Equipment Co.
Victor Welding Equipment Co.
Weldit Acetylene Co.
Williams & Co.

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VALVES
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WELDING COMPOUND (for Shape Welding
Air Reduction Sales Co.
Harris Calorific Co.
Modern Engineering Co.
National Carbon Co.

WELDING RODS AND WIRE
See "Electrodes" and "Acetylene Welding Wire"

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Thanks for the proof. SWEDOX sure is the wire for us!

FOR every welding requirement there is a SWEDOX wire that is right. We first prove it to ourselves; then we are prepared to prove it to you. An inquiry describing your work will put you in line for more carefully selected welding wires and electrodes —merit-proven in every respect.

Central Steel & Wire Company

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4545 S. Western Blvd.
Lafayette 8500

DAYTON, OHIO
East Monument Ave.
Extended
East 150

DETROIT, MICH.
5001 Bellevue Ave.
Whittier 6780

SWEDOX

WELDING RODS, WIRES and ELECTRODES

The Progressive Keynote

Since gauges were first made for welding equipment the National Gauge & Equipment Corporation has consistently maintained its leadership in this field.

In the Natweld line the progressive keynote has always been dominant. Not content with making a superlatively good instrument, this Company has continued its research and experimental work at all times, and as a consequence has been able to effect constant improvements in design, in materials and workmanship.

And, not the least interesting of all these developments has been effected by the volume production resulting from the great demand for Natweld Gauges. As a direct result these outstanding gauges are now priced very low.

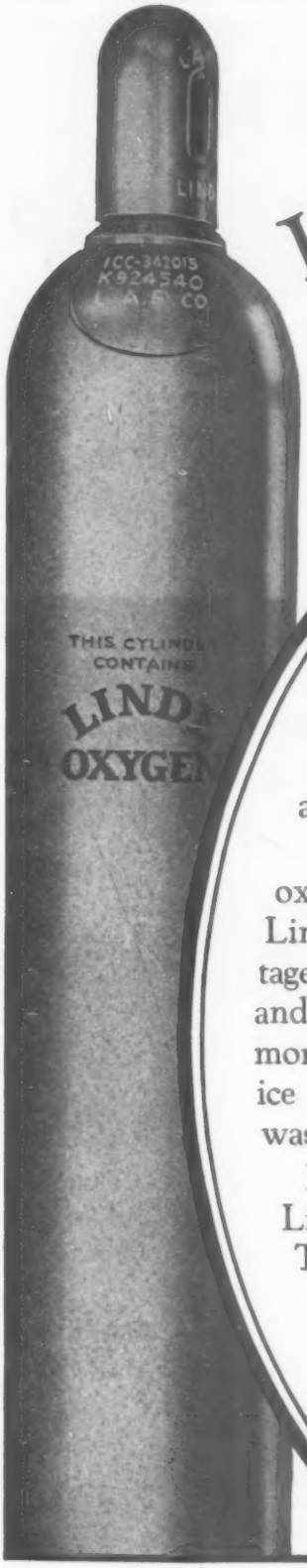
Represented in Illinois, Indiana, Wisconsin, Minnesota and Missouri
by Joseph Halla
333 North Michigan Ave., Chicago, Ill.

MotoMeter Gauge & Equipment Corp.,
820 Tower Court, Chicago

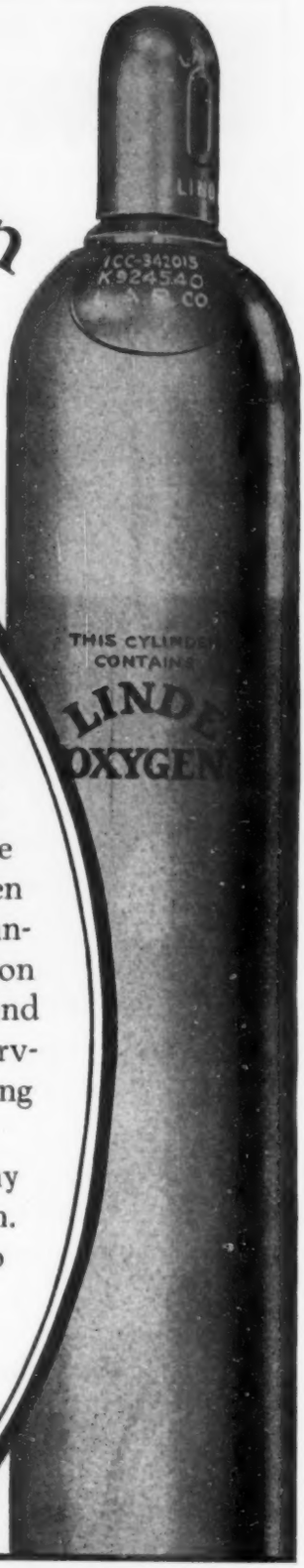
MotoMeter Gauge & Equipment Corp.,
15 Wilbur Ave., Long Island City, N. Y.

MotoMeter Gauge & Equipment Corporation

15 Wilbur Ave., Long Island City, N. Y.



Lower Production Costs through Linde



"One-fifth

off our entire production cost of steel barrels is the result to us of Linde Process Service," says a prominent manufacturer, "an annual saving running well into five figures."

This manufacturer was effectively using the oxy-acetylene process of welding and cutting when Linde was called in. He was already taking advantage of all its apparent economies in both production and maintenance. Still, through the broader and more comprehensive experience of the Linde Service organization, this important additional saving was effected.

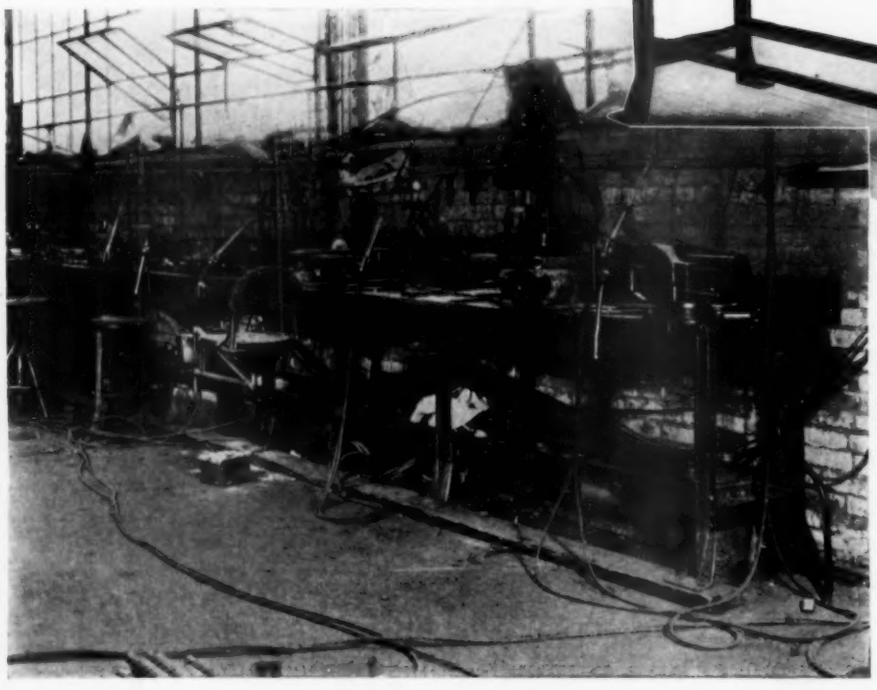
Linde Process Service is but one reason why Linde Oxygen has the greatest sale of any oxygen. This Service is available without cost to Linde users.

THE LINDE AIR PRODUCTS COMPANY
Unit of Union Carbide and Carbon Corporation

64 Plants UCC 154 Warehouse Stocks
General Offices: Carbide and Carbon Building
30 East 42nd Street, New York

LINDE OXYGEN

WOOD WON'T DO



PAT'D AND PAT'S PENDING

"HALLOWELL" Steel Work-Bench

Cut above shows details of construction which is identical with that of the "HALLOWELL" in the picture on the left.

"Hallowell" Welding-Bench of Steel
A Recent Installation in an Aeroplane Factory

For hot work, such as suggested by the many welding-torches in the big picture "HALLOWELL" Steel Benching that can't burn is the very, the only thing.

The Bench Top, Bench Legs, Bench Drawers, are all of "HALLOWELL" Steel Construction, strong and durable; and considering how the bench is littered with all kinds of paraphernalia it certainly needs to be made of stern stuff to stand the racket without splintering, cracking and wearing out in a short time.

But to fully appreciate our "HALLOWELL" Steel Benching Equipment

Better Get Our Bulletin 386

We carry 1368 combinations of lengths, widths, heights, and weights of "HALLOWELL" Steel Benching in stock for immediate shipment.

STANDARD PRESSED STEEL CO.

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BOX 536

BRANCHES
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ROEBLING

WELDING WIRE

Strong Welds are made only when the best electrodes are used. Roebling Welding Wire is manufactured to meet the most rigid specifications. It is uniform in quality throughout each shipment and throughout all shipments. Look for the ® trade mark stamped on each electrode.

Catalog A-529

John A. Roebling's Sons Company, Trenton, N. J.

-*for* welding in any position

A mercury-vapor unit delivering 10,000 kw. in high-pressure steam and 10,000 kw. in electric energy is in service at the South Meadow station of the Hartford Electric Light Company. All welds in the vapor pipes and main mercury-vapor header were made with G-E arc-welding sets and G-E Type "F" electrode. When tested under 100 pounds of air per square inch, only three pinhole leaks were found in 80 such welds.

Type "F" electrode demonstrated more than its ability to effect pressure-tight welds. It was, in turn, applied in flat, vertical, horizontal, and overhead positions. Operators appreciate an electrode which is easily handled in awkward positions and which, at the same time, gives uniform results.

For prompt service or additional information as to various types of G-E electrodes, get in touch with the G-E welding Electrode Distributor near you or write to Section E-5312, Merchandise Department, General Electric Company, Bridgeport, Connecticut.

In simplicity, reliability, and ease of operation, G-E arc-welding sets are unequalled. They are available in all sizes, all types—for either hand or automatic operation—for one or more operators.

550-517

JOIN US IN THE GENERAL ELECTRIC HOUR, BROADCAST EVERY SATURDAY AT 9 P.M., E.S.T. ON A NATION-WIDE N.B.C. NETWORK

GENERAL ELECTRIC

MERCHANDISE DEPARTMENT, BRIDGEPORT, CONNECTICUT

IN THESE CHASE WELDING RODS

CHASE

Chase Chamet Bronze Welding Rod . . Chase Manganese Welding Rod . . Chase Brass Welding Rod

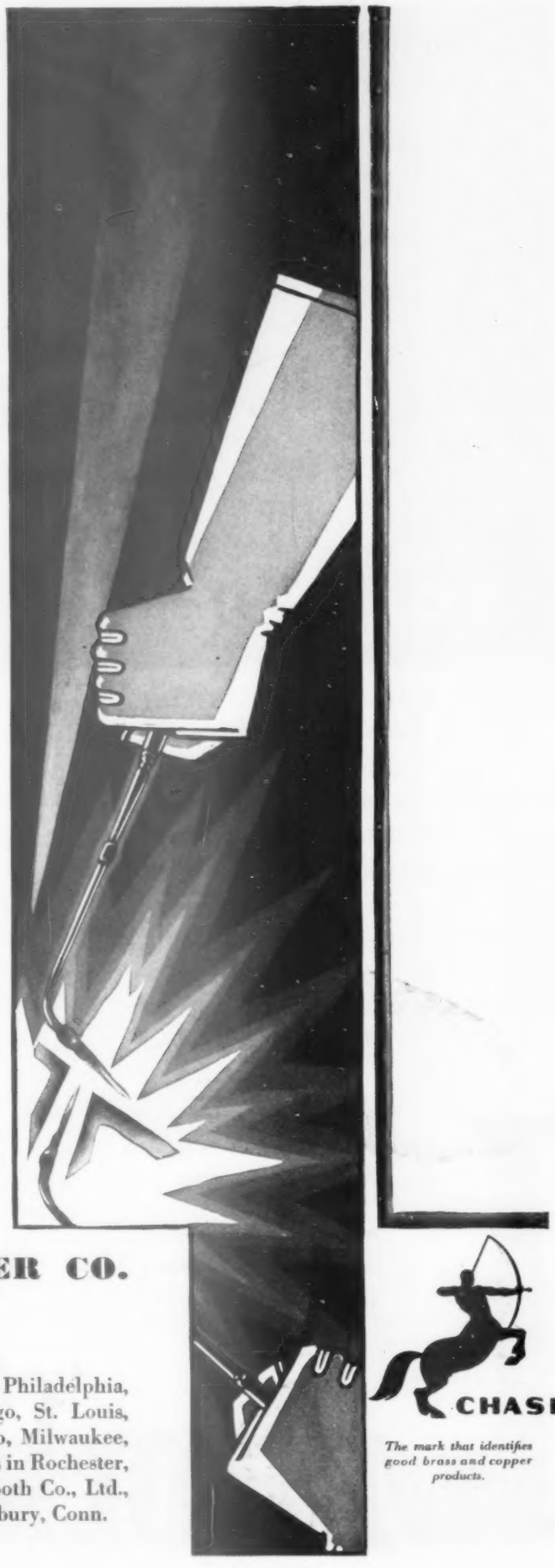
Everything you demand of a perfect welding metal

Close-grained and strong . . . melting at just the right temperature and free flowing . . . free from any of the porosity that causes sputtering and explosions . . . in fact, all the qualities you look for in a good welding metal you'll find in the rods stamped with the unmistakable Chase mark. In all these rods—Chase Welding Rods in Brass, Manganese Bronze and Chāmet Bronze—you can be sure of the same high quality that insures a strong, lasting weld.

Always look for the Chase mark indelibly stamped on every length of genuine Chase Welding Rod. It is your guarantee of the qualities you demand.

Plus Chase Warehouse Service

One of the eighteen Chase Warehouse Stocks is near you. Call there for *immediate service.*

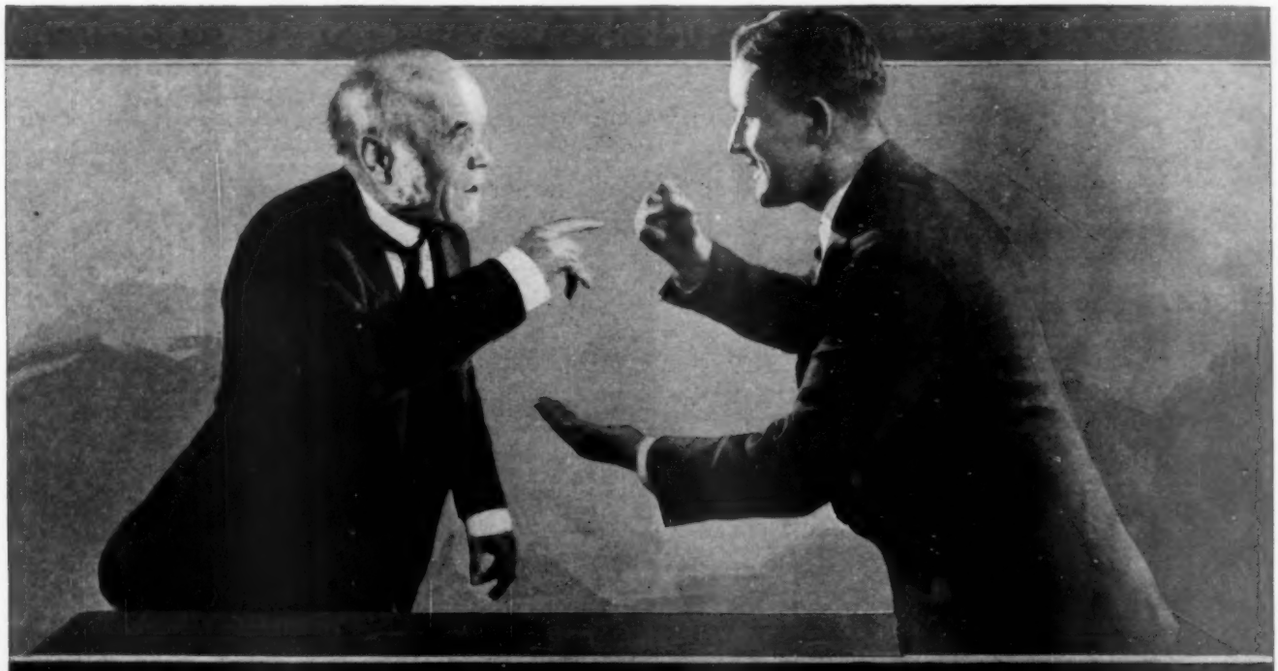


CHASE BRASS & COPPER CO.
—Incorporated—
Waterbury, Connecticut

WAREHOUSES—New York, Boston, Newark, Philadelphia, Baltimore, Cincinnati, Cleveland, Detroit, Chicago, St. Louis, New Orleans, Los Angeles, San Francisco, Buffalo, Milwaukee, Minneapolis, Seattle, Oakland. (Also Branch Offices in Rochester, Pittsburgh and Dallas.) Canadian Rep.: W. E. Booth Co., Ltd., Toronto, Ontario. Mills and Home Office, Waterbury, Conn.

CHASE

The mark that identifies good brass and copper products.



TRADITION PROGRESS

"Here, Lad—

You couldn't be so enthusiastic about 'Stable-Arc' welders if vou didn't see something in them.

Just what DO you see?"

"Easy, Pop—

Sincerity is the first thing evident.

The arc welder is sold to a manufacturer who is expected to design his machinery for arc-welded production.

Now, the arc welder too is a piece of machinery.

If on the welder you see a welded frame generator driven by a welded frame motor, doesn't that inspire confidence in the sincerity of that welder maker's argument—viz: that you can build a thing better by arc welding.

The Lincoln 'Stable-Arc' welder is the answer since it's the most successful welder and is a *completely* arc-welded ensemble—motor, generator, frame, wheels and all.

It's a welded union—not a mixed marriage."

The Lincoln "Stable-Arc" Welder

— welds easier
— makes better welds
— permits greater output because of the steady uniform arc throughout entire welding range, which is the result of:

- **Variable voltage design**
- **Laminated magnetic circuit**
- **Separately-excited generator field**
- **Double control of welding heat**
- **All steel construction**

No other welder has all these features.

The Lincoln Electric Co.,
Dept. No. 27-12, Cleveland, O.

"Stable-Arc" LINCOLN WELDER

W-122

"Three Generations of Brass Making"
Do Make a Difference in the Finished Product

Mueller
WELDING
BRONZE ROD

Mueller
Makes

Red Tip Brass Rod
Brass and Copper Forgings
Nickel Silver Rod and Forgings
Tuf-Stuf Rod and Forgings
(Corrosion Resisting Metal)
Brass Castings
Brass Screw Machine Parts
Mueller Blue Tip Bronze Rod
Brass and Copper Seamless Tubing
Mueller Blue Tip Bronze Welding Rod
"600" Bearing Metal
Airplane Fittings
Electric Refrigeration Valves and Fittings

IF you have never used Mueller Welding Bronze Rod you are overlooking a product that will enable you to do better work and to do it in less time.

Quality isn't left to chance in Mueller manufacture. Careful analysis of each heat as it is poured insures a uniform product.

Mueller Welding Bronze Rod makes sound, strong, non-porous welds. It flows evenly and freely. Absence of porosity eliminates sputtering and explosions.

Find out for yourself the Quality of Mueller Welding Bronze Rod. We'll gladly mail you a generous sample free. Drop us a line with your address, we'll do the rest.

Mueller Brass Co.
PORT HURON MICHIGAN
DETROIT DISTRICT

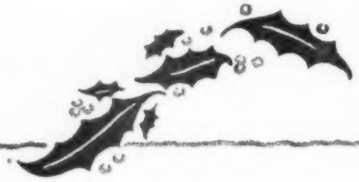
Mueller Brass
THREE GENERATIONS OF BRASS MAKING

Greetings

from

American Steel & Wire Company

Again the Yuletide, with its inspirations of good cheer is with us—the New Year approaches—and we sincerely extend to you our very best wishes for a very MERRY CHRISTMAS and a HAPPY, PROSPEROUS NINETEEN THIRTY»»»



American Steel & Wire Company

SUBSIDIARY UNITED STATES STEEL CORPORATION

208 S. La Salle Street, Chicago — 30 Church Street, New York

Other Sales Offices: Atlanta, Baltimore, Birmingham, Boston, Buffalo, Cincinnati, Cleveland, Dallas, Denver, Detroit, Kansas City, Memphis, Milwaukee, Minneapolis-St. Paul, Oklahoma City, Philadelphia, Pittsburgh, Salt Lake City, St. Louis, Wilkes-Barre, Worcester

U. S. Steel Products Co.: San Francisco, Los Angeles, Portland, Seattle, Honolulu

Export Distributors: United States Steel Products Co., 30 Church St., New York City

"Oxweld carries on when the others quit . . ."

A STUDENT engineer characterizes the above phrase as "my simplest way of expressing the reason for my choice of Oxweld equipment as being superior to others." This young man had just completed his curricular requirement in oxy-acetylene welding and cutting at a prominent engineering school. Ninety-two per cent of his classmates also chose Oxweld.

There is a similar marked preference for Oxweld in industry. The reason is economic. Oxweld blowpipes, embodying the Oxweld low-pressure injector principle, give more welding, more cutting, more hours, months and years of operation. They carry on when the others quit.

Reliable—Economical—Long-Lived
Typically Oxweld

OXWELD

WELDING AND CUTTING APPARATUS AND SUPPLIES

OXWELD ACETYLENE COMPANY
Unit of Union Carbide and Carbon Corporation

NEW YORK
Carbide and Carbon Bldg.

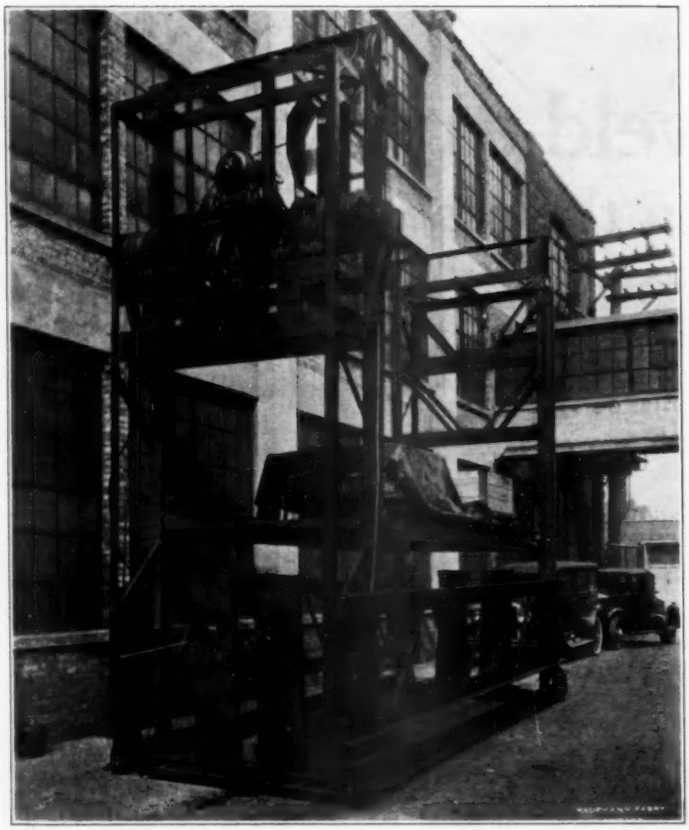
UCC

CHICAGO
Carbide and Carbon Bldg.

SAN FRANCISCO
Adam Grant Building

STOCKS IN 38 CITIES

IN CANADA: DOMINION OXYGEN CO., LTD., TORONTO



Portable Elevator, capacity 30,000 lb., all-welded with Hollup Wire.

Where *Strength* Is Needed

Sound, homogeneous welds require that the electrode material be of such composition as to give the weld metal the desired physical character, and to possess such flowing quality that thorough fusion is easily obtained. Strong welds are a characteristic product of Hollup Wire, because it contains these desirable qualities. These qualities of Hollup Wire are guarded carefully from the initial production of the steel through to the finished product.

Write for Bulletin

HOLLUP CORPORATION

3333 W. 48th Place
Chicago, Illinois

269 37th Street
Brooklyn, N. Y.

HOLLUP ELECTRODES

Two Problems of Simple Mathematics

I. 2000 lbs. Pressure + 1 Seat and Diaphragm = Inaccurate Regulation and Trouble.

II. 2000 lbs. Pressure + Harris Multi-Stage Regulation* = Accurate, Dependable Regulation and No Trouble.

*HARRIS

PATENTED
Others Pending
U. S. A. and
Foreign Countries

Approved by
The Underwriters

GAS PRESSURE REGULATION

reduces the 2000 pound tank pressure to a practical, constant sub-pressure by means of a fixed seat and diaphragm. An additional controlled seat and diaphragm regulates this reduced pressure to the desired working pressure and assures accurate, dependable regulation, uniform pressure and volume delivered — No Trouble.

Manufactured by

HARRIS CALORIFIC COMPANY - CLEVELAND, OHIO

For demonstration, literature and further information consult nearest "Harris" distributor listed below:

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Moore-Handley Hdwe. Co...Birmingham, Ala.
Eastern Service Company.....Boston, Mass.
International Oxygen Co.....Buffalo, N. Y.
Welders Supply Co.....Canton, Ohio
National Oxygen Co.....Chicago, Ill.
Buckeye Welding Supply Co..Cleveland, Ohio
Welding Metals Mfg. Co.....Detroit, Mich.
Smithweld Equipment Co....Ft. Worth, Texas
Smithweld Company.....Houston, Texas
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Logansport Oxygen Company..Logansport, Ind.
H. A. Mackey.....Los Angeles, Calif.
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Modern Welders Supply House.New Orleans, La.
Balbach Company.....Omaha, Nebr.
Harris Sales Co.....Philadelphia, Pa.
Pittsburgh Thermoline Co....Philadelphia, Pa.
Hope Construction & Refining Co.Pittsburgh, Pa.
Martin's Service Co.....Pittsburgh, Pa.
Pittsburgh Thermoline Co.....Pittsburgh, Pa.
Cook Iron Store Co.....Rochester, N. Y.
Poss & Shaw, Inc.....San Francisco, Calif.
Welding Service Co. .....Scranton, Pa.
Blue Tank Oxygen Co.....Seattle, Wash.
Seattle Hdwe. Co.....Seattle, Wash.
Washington Mchy. & Supply Co.Spokane, Wash.
International Oxygen Co.....Tariffville, Conn.
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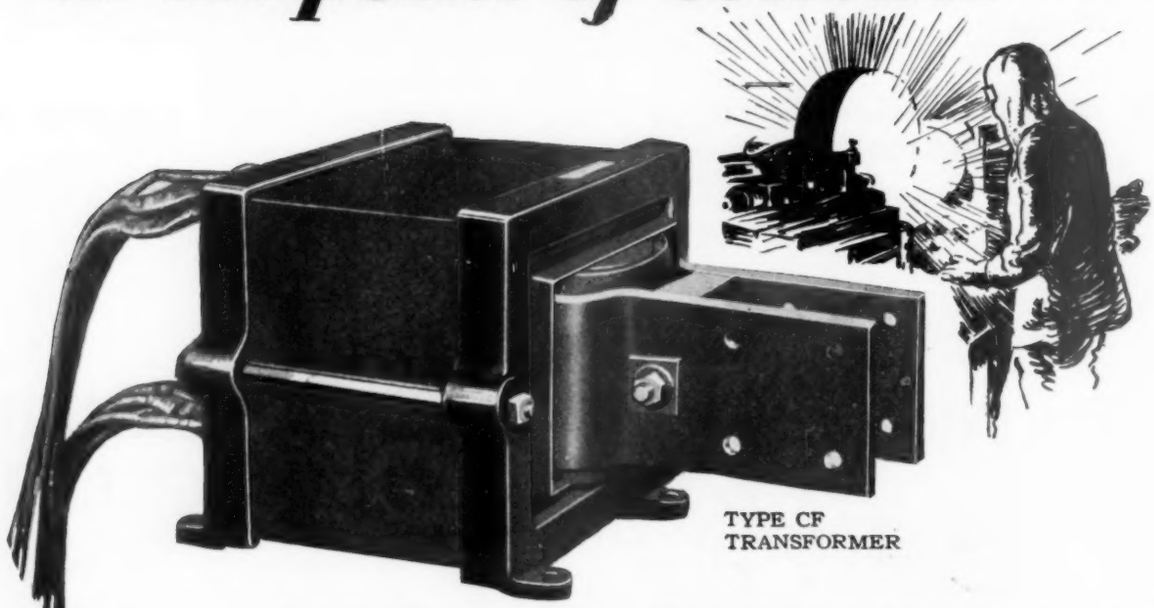
Carter Torch & Supply Co..Hamilton, Ontario
H. B. Holden Company.....Windsor, Ontario
Seattle Hardware Co..... Alaska
Seattle Hardware Co.....Honolulu, T. H.
Tropical Sales Agency .....Havana, Cuba

Heat Control
at the point of contact ‹‹‹



TYPE CF
TRANSFORMER

In welding, riveting and all operations where metals are fused, perfect control of the heat application is essential. Keeping pace with developments in the fusing of metals by electrical processes the American Transformer Company has developed a line of heat control transformers for every purpose.

Many large industrial companies* are using Type CF Transformers for stepping down the line voltage to the proper low voltage required for welding. These transformers can be used for heating, welding, riveting, testing of current transformers, switches, circuit breakers, or in other similar applications where heavy current low voltage is required.

The secondary of this Type CF Transformer is made up of bus bar type copper. It has very high conductivity and provides convenient means for connecting to the secondary circuit. The primary is provided with taps for controlling the power output on the secondary. Range in the secondary voltage has about 50% variation. The secondary can be wound in two coils so as to obtain double voltage range by connecting in series or in parallel.

For further information write for Bulletin 1040. We supply transformers for every laboratory and industrial use.

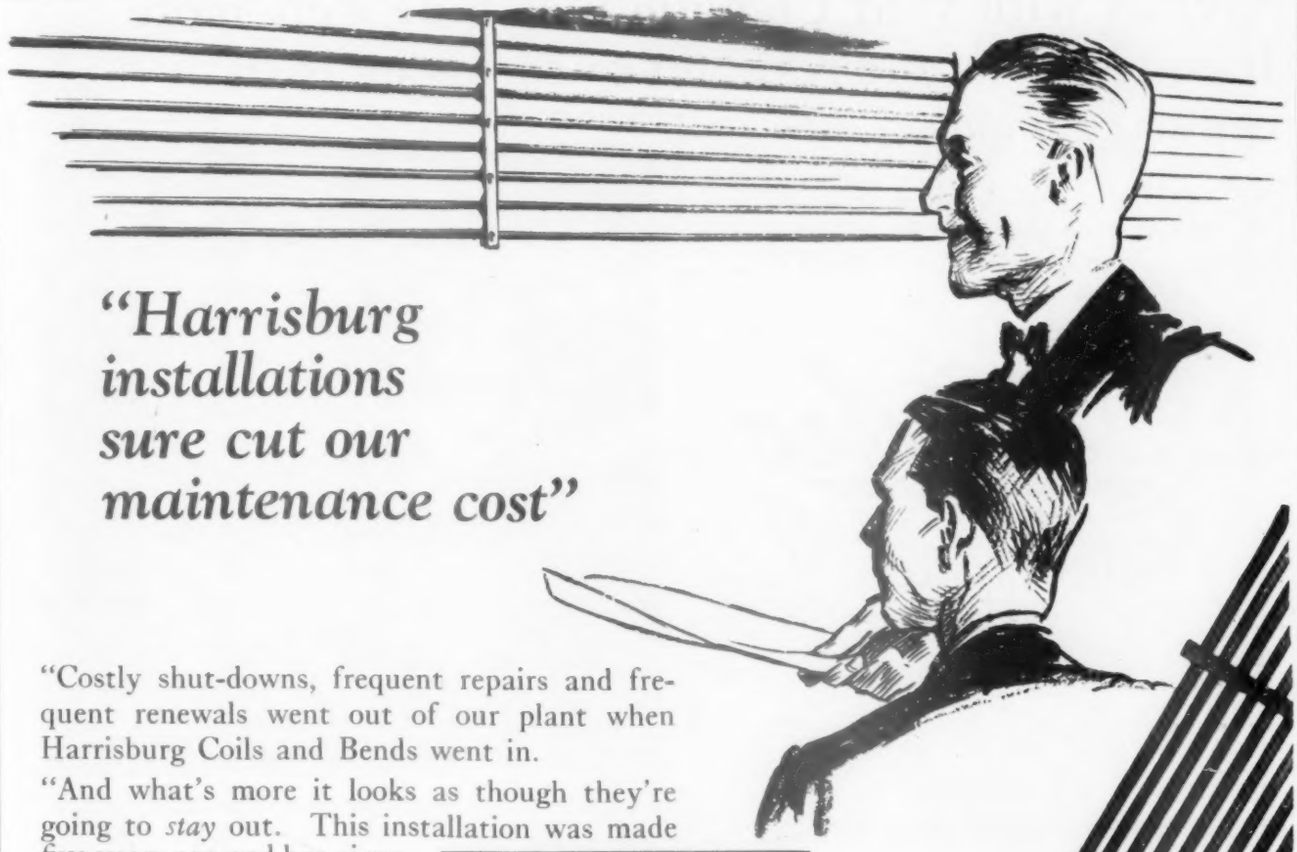
AMERICAN TRANSFORMER COMPANY
188 EMMET STREET NEWARK, N. J.

* Names on request.

Representatives

Atlanta, Ga.—H. Douglas Stier, 101 Marietta Street
Chicago, Ill.—L. C. Hermann, 4433 North Richmond Street, Ravenswood Station
Knoxville, Tenn.—Arthur L. Pollard
Minneapolis, Minn.—Elliott Equipment Co., 708 Sixth Avenue, South
Montreal,—Canada W. O. Taylor & Co., Ltd., 415 Canada Cement Bldg.
Philadelphia, Pa.—L. D. Joralemon, 112 South 16th Street
San Francisco, Calif.—James H. Southard, 682 Mission Street
St. Louis, Mo.—J. W. Jones, 432 Pennant Building

AMERICAN TRANSFORMERS



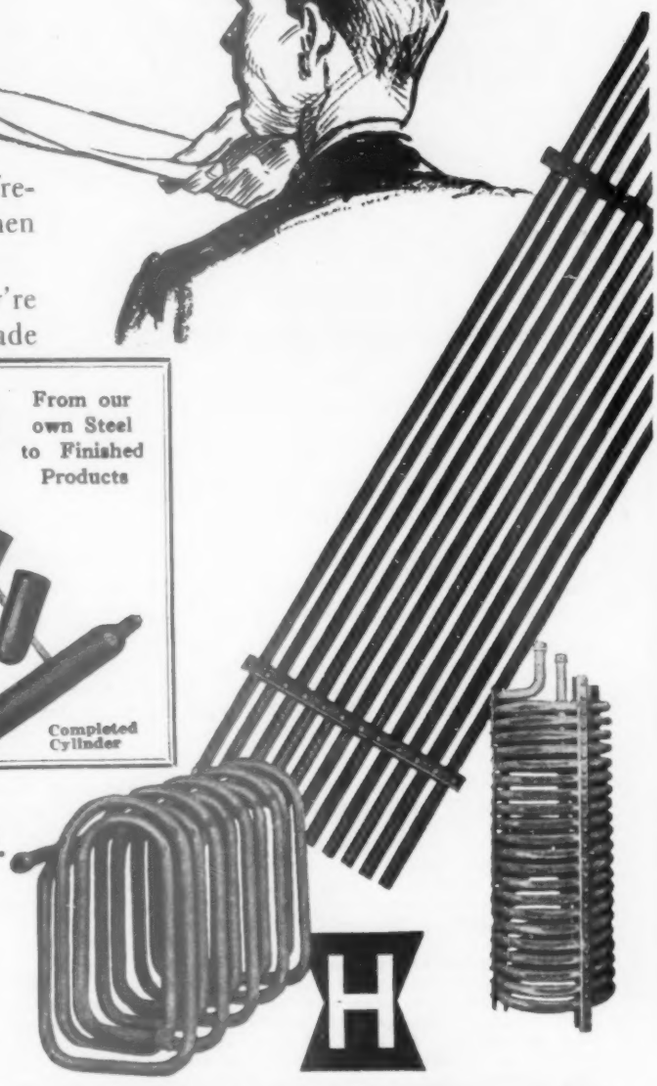
"Harrisburg installations sure cut our maintenance cost"

"Costly shut-downs, frequent repairs and frequent renewals went out of our plant when Harrisburg Coils and Bends went in.

"And what's more it looks as though they're going to *stay* out. This installation was made five years ago and has given 100% trouble-free service ever since.

"It takes exceptional facilities, plus real experience, to turn out coils and bends to suit us — and Harrisburg has both.

"Why not let Harrisburg quote on your requirements?"



HARRISBURG PIPE & PIPE BENDING CO.
HARRISBURG, PA.

Fully Equipped with Our Own Open Hearth Furnaces, Rolling Mills and Forge Shops

Makers of Alloy Steels in Slabs, Billets, Bars, Strips, Shapes and Hollow Forgings; Pipe Coils and Bends, Couplings and Cylinders.

HARRISBURG

COILS AND BENDS

"Welds with your Uranium Electrode were more homogeneous and resistant to corrosion than ordinary welds."

BECAUSE of their proven superior qualities as indicated in the accompanying letter, the Portland (Ore.) Gas & Coke Company specifies

Quasi-Arc

Electrodes

for repair and replacement work.

Wherever welds of great strength, with high resistance to corrosion and with high immunity to fatigue from impact and torsional and vibrational stresses are essential, work done with Quasi-Arc Electrodes will be found superior.

PORTLAND GAS & COKE COMPANY

PUBLIC SERVICE BUILDING

PORTLAND, OREGON

Quasi-Arc Incorporated
11 West 42nd Street,
New York, N. Y.

July 25, 1929

No. 1438 Attention: Mr. H. S. Ayres

Gentlemen:

In reply to your letter of July 19th, we have no objection to the use of the photos of our agitator in connection with the name of our company in your advertising.

The agitator is used in the process of refining benzol and toluol for motor fuel purposes and the rubber and paint industries. The crude light oil is washed with concentrated Sulphuric Acid which is followed by Caustic Soda solution. An agitator with seams welded with bare wire electrodes, after five years service shows the weld metal entirely corroded away from the inside seams of the agitator shell.

Laboratory tests indicated that welds with your Uranium electrode were more homogeneous and resistant to corrosion than ordinary welds, which led us to decide on the use of Uranium rods in welding the new agitator. In fact we are, wherever conditions to which our apparatus is subjected are corrosive, making repairs and replacements with Quasi-Arc welded material.

Yours very truly,

Portland Gas & Coke Company

E. Ed. HALL

General Superintendent.

Then there is the further advantage of saving in time, labor, material and money. The labor saving runs from 30 to 50 per cent, and there is less dependence upon the skill of the operator

As the weld metal from Quasi-Arc Electrodes is stronger, a smaller and quicker placed deposit is justified, and the strength is so uniform that calculation of the performance of the weld can be accurate and dependable.

That Quasi-Arc Electrodes will give you better welds at lower costs has been proven throughout the world by records of efficiency and economy which cannot be questioned. These records together with other convincing proof will be submitted to you by Quasi-Arc Service Engineers.

Quasi-Arc Electrodes are supplied in various diameters and in pure metal or alloy compositions. They are equally advantageous on new construction or small repair work, and are often the only means for meeting strict specifications on important jobs.

If you are not already thoroughly posted on Quasi-Arc Electrodes and their distinct superiority, you are overlooking one of the greatest opportunities in the welding industry.

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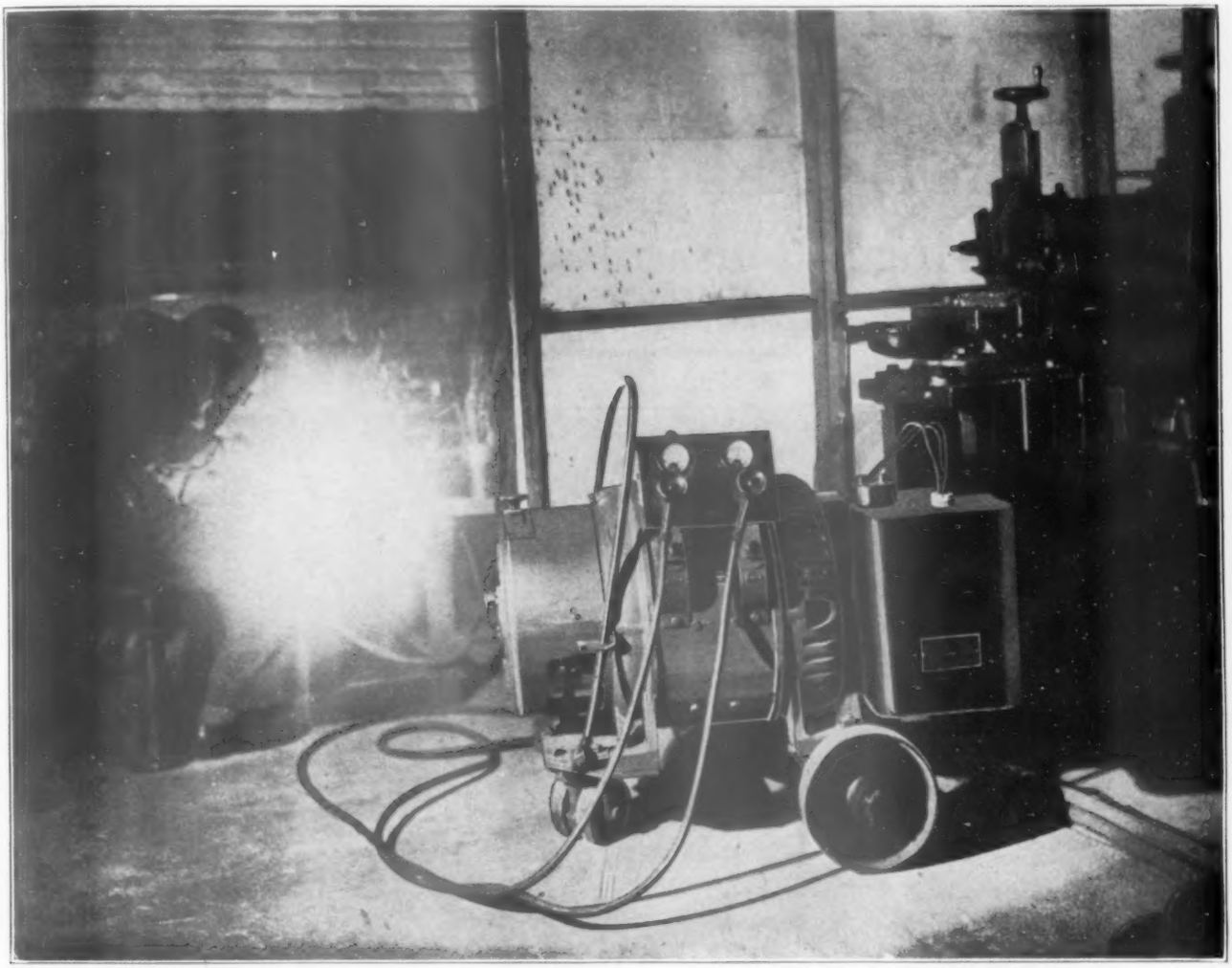

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"Gas welding and cutting of pipe in buildings will increase 100% in 1930, because it is better and costs less."

Ask a member of the Gas Products Association for information and a demonstration (if you are not already familiar with the saving and greater efficiency of gas welding and cutting of pipe in building construction) or address the Association at 608 South Dearborn Street, Chicago.

A 200-ampere set used in the fabrication of dump-truck bodies.

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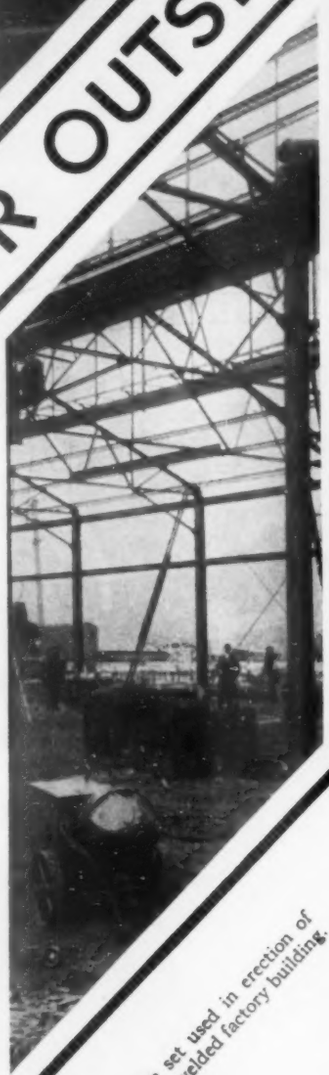

A 200-ampere set used in erection of an 816-ton arc welded factory building.

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IN the factory or out in the field—you can depend upon a Westinghouse welder to do a full day's work.

Greater welding speed is made possible with Westinghouse sets because the generator is separately excited, assuring instantaneous response to changing arc conditions. This gives an arc which is easy to strike and maintain. The welding current may be adjusted quickly and accurately by a single dial rheostat.

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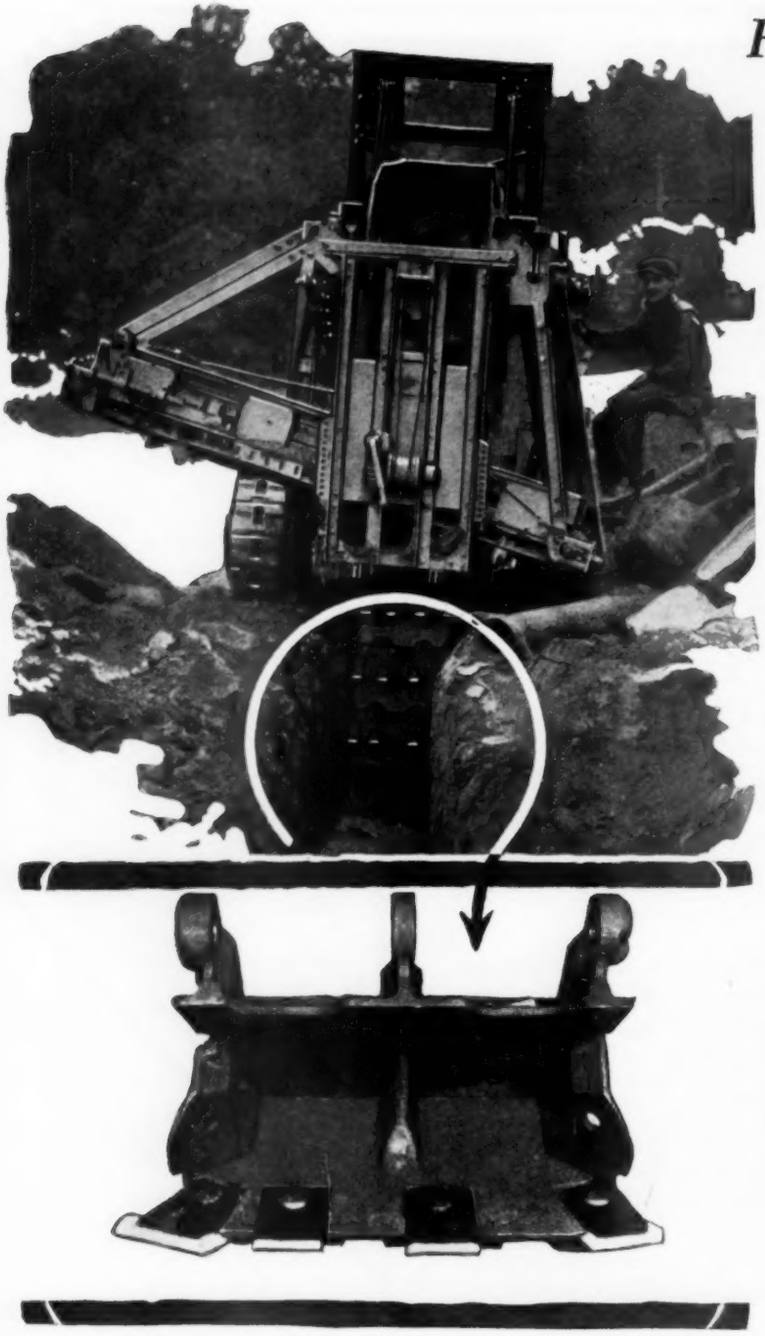

Haynes Stellited Barber Greene Ditcher Teeth Last Four to Five Times as Long

A STUDY of time and production losses incident to replacement of worn parts prompted Barber Greene engineers to make a thorough investigation of wear-resisting, hard-surfacing alloys. This investigation developed the fact that ditcher teeth coated with Haynes Stellite last four to five times as long as hardened steel teeth and average less than three times the cost. As a result, the Barber Greene Company has standardized on Haynes Stellited teeth, thus insuring the greatest possible durability and dependability of their ditching machines.

The wearing faces of ditcher teeth, and similar working parts operate under highly abrasive conditions. Resistance to wear is therefore an important property of such parts. Specify Haynes Stellite on your wearing surfaces. It resists abrasive wear better than any other hard facing alloy.

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HAYNES STELLITE COMPANY

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Haynes Stellite welding rod is also available from any of the 28 District Sales Offices of Oxweld Acetylene Company

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KELLY-DEMPSEY COMPANY
PIPE LINE CONTRACTORS
1221 HUNT BUILDING
Tulsa, Oklahoma

September 19, 1929

Victor Welding Equipment Company
844 Folsom Street
San Francisco, California

Attention: A. S. Measley

Gentlemen:

Your company has asked us to comment on Victor Welding equipment and will say that it has proven very satisfactory on pipe-line work. We have at the present time, about 100 Victor welding outfits complete in our company, and I really believe that this equipment will save its cost every thirty days in actual operation over any other make of torch that we are acquainted with.

The savings that I speak of is the saving in oxygen and repair parts also we find the welders are able to turn out considerable more work with the Victor equipment than with any other equipment. Hoping this is the information you desire, we remain

Yours very truly,

KELLY-DEMPSEY & COMPANY

BY O. E. Dempsey

OED:EK

The letter reproduced on this page is a straight-from-the-shoulder reason why experienced *Welders* everywhere insist on *Victor Equipment.*

Your *Victor* Dealer will be glad to arrange a demonstration or supply you with *Victor* apparatus to test on your job. One or a hundred, the same *quality* is built into every piece of *Victor* apparatus.

Victor Welding Equipment Co.

844 Folsom Street **San Francisco, California**

EDITORIAL

Rolled-up Sleeves Again in Style

WHEN the prodigal son, after following an elusive rainbow, returned to his father, joy reigned supreme. If the story had not ended there we would probably find that the son was tickled pink to get out into the fields and work once again for the old man, and to take some of the load off his jealous brother, who had been sweating under the summer sun while the prodigal himself had wasted his inheritance in a far-off land. The prodigal again has returned. The rainbows in Wall Street and La Salle Street have faded away. The penitent has his feet under a desk and his sleeves rolled up. Those about him who have tried to keep things on an even keel while he was gone feel no jealousy toward him, but rather pity. Now they are all working together for bigger things, based on actualities and not on idle dreams. That is the picture today of American business, according to those who have made a searching investigation of present conditions and ought to know. A symposium of business-paper editors regarding the outlook for business, conducted by the National Conference of Business Paper Editors, indicates that prospects are excellent for the businesses ready to apply the needed additional sales-effort drive, but only those companies that will extend themselves to the utmost will come through the coming year with profits up to the level of the last few years. No trade or industry, it is reported, has been distinctly crippled by the sudden decline in stock-market prices. Industry in general has not been overproducing, and stocks on hand of raw materials and finished products are low enough for whatever period of retardation may take place. "General manufacturing, as measured by the monthly consumption of electric energy by the factories of the country in October was at a rate 3.9% above October last year," states a summary of this symposium prepared by the Editorial Advisory Committee of the National Conference. "The textile industry gave little indication of any reaction, and October as a whole was a good month. Engineering construction has declined steadily since May, the October lettings being 4% under October, 1928. With money again available for mortgages, building operations on a large scale are anticipated. Sales of airplanes are slackening with the approaching winter season. Demand in the machinery and machine-tool industry is holding up well. Non-ferrous-metal mines, mills, and smelters continue active, although the stock-market crash has adversely affected sales and prices. Some curtailment in production will be witnessed in the radio industry, but this will not be general. Unseasonable weather has slowed down business in the coal markets of the country. Automobile production is being stringently curtailed, but the industry is financially sound. Many important industrial developments and modernization projects are being announced. Less luxury sales and more necessity buying are prevalent in the boot and shoe field. Trade in the chemical industry is expected to slow up in the next few months. Steel-ingot production during October declined 7.4% against an average increase for the same period during the last five years of 3.9%. New financing in the electric light and power industry was materially decreased. Agricultural conditions are sound, and farmers as a whole are optimistic for the first time in years. Financially the country was never stronger, and money is again flowing into trade and industry and is available at reasonable rates." In the building and construction field, the opinion is unanimous that the break in stock prices will result in making investments in building operation distinctly attractive and that this, after the temporary general decline is past, will stimulate building and construction in all branches. Residential building, which has been much below normal for a year, will go ahead rapidly. All in all, any unwholesome factors that exist in the present situation will be sufficiently counterweighted by easy-money conditions, by increased public improvements and a psychology of optimism growing out of the White House conferences, and by a general determination of business to "carry on," that it can be stated as a general proposition that those businesses who "roll up their sleeves" have a good year ahead of them.

Machine Cutting

THERE seem to be a number of manufacturers of machinery who are not acquainted with the importance of machine cutting as an auxiliary process to welding when welded steel is substituted for iron or steel castings and forgings. When the question of using welded steel for this purpose comes up there is quite apt to be some experimental work done in which the hand cutting torch is used as a basis for judging the quality of the product and also the economy of the process. It is a mistake to make these experiments on the basis of hand cutting in cases where machine cutting would probably be used if the idea got into full production. The work of the mechanically operated cutting torch is smoother, easier to weld and cheaper than the work of the hand torch. Machine cutting, has, in fact, possibilities for the complete fabrication of metal parts which have not been fully realized. The author of one paper read before the recent meeting of the International Acetylene Association gave a striking example of this when he told that a machine which had been originally installed with the idea that it could be kept at work eight hours a day was almost immediately in operation on a twenty-four hour schedule. It is almost impossible to compile a list of the possible uses of machine cutting which will give an individual plant manager an idea of its usefulness to him. But let him once get it into operation on the things it convinces him it could do and he is apt to be amazed at the many unexpected jobs for it which are developed by experience.

Tackling the Problem of Sales Cost

IT is of general knowledge that the cost of distributing manufactured products has not fallen off at the same rate as the decrease in the cost of production of these products, and in many instances the cost of distribution has increased and eaten up most or all the profits that accrued from lower production costs. In recognition of this fact, the coming Census of Distribution to be taken for the first time by the Bureau of the Census during the year 1930 will bring together data of such nature and arranged in such form that it will be of material value in establishing market possibilities and sales quotas both by groups and individual producers, in analyzing the relations between volumes of different and of similar commodities distributed in various territories, and in making studies of living and housing costs, living standards, and other studies of a social or economic nature. The possibilities to business generally in a census of this kind are tremendous, but the success of the undertaking is largely dependent on the business houses and manufacturers themselves. Such data as those desired are of no value unless they are very nearly complete. It is anticipated that such data will be an important factor in outlining the way to reduced distribution costs, which in turn should result in reduced commodity costs, and the next step, which automatically follows, is an increased standard of living. Hence manufacturer, distributor, and consumer all will profit from this undertaking.

Welding and Cutting with City or By-Product Gases

WE believe that notable achievements have been made in cutting and welding with illuminating, natural and similar widely distributed gases. We are convinced from our developments that there are great possibilities in this practically unlimited field and that vast sums can be saved by this process and the art of cutting made more universal.

In order to encourage and aid the development of this art we are offering for the best authenticated results obtained by cutting or welding with such gases

THREE THOUSAND DOLLARS ($3,000.00)

to be paid $1,000.00 each year for the best authenticated article sent to us in the years 1930, 1931 and 1932.

Particulars of the conditions under which such data must be furnished and the methods of determining the awards will be furnished upon application.

This Company will aid individuals or companies seeking to make the necessary experiments with apparatus at nominal costs and will also help to develop or finance any improved methods or systems which may warrant such development.

THE ALEXANDER MILBURN COMPANY

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WELDING and CUTTING EQUIPMENT

ESTABLISHED 1907

Welding in the Power Plant

Not Only Is Welding a Time and Money Saver in New Plant Construction, but Welded Joints Increase Operating Efficiency

By William H. Zorn*

AT the peak of activity in 1929, the Detroit Edison Co. had in use 60 direct-current welding units and were employing 100 operators. This was accomplished by the use of double shifts, although at present these units are used on single shifts.

Included in this equipment are three combination gasoline or power electric units mounted in trucks. These units are fully equipped for electric or oxy-acetylene welding and cutting and are used on shut-down jobs and in out-lying locations, in a territory embracing a circumference of approximately 225 miles. These units pay for themselves in six months by the savings they make.

Two welding units driven by Fordson tractors are used in the welding of gas mains. Seventy-five oxy-acetylene outfits are used in conjunction with this equipment.

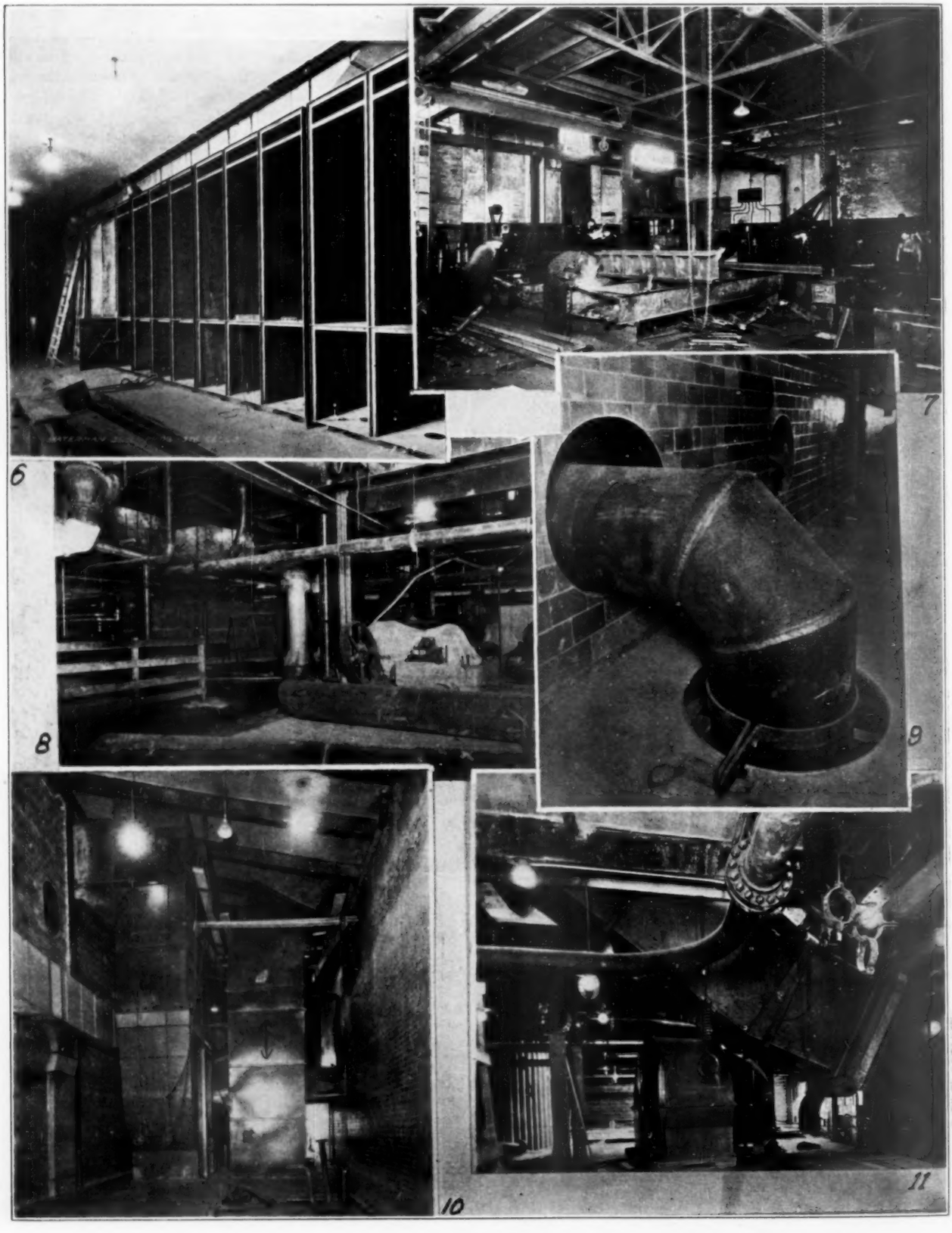
In 1926 the Detroit Edison Co. was using about six electric

*General Foreman of Welding, Detroit Edison Co.

welding machines and employing about ten electric and oxy-acetylene operators. A disappointing attempt to weld some pulverized-coal bunkers had not helped to increase the use of welding. Moreover, design suited for riveting and not for welding had left a general attitude of pessimism, which, however, has been completely overcome.

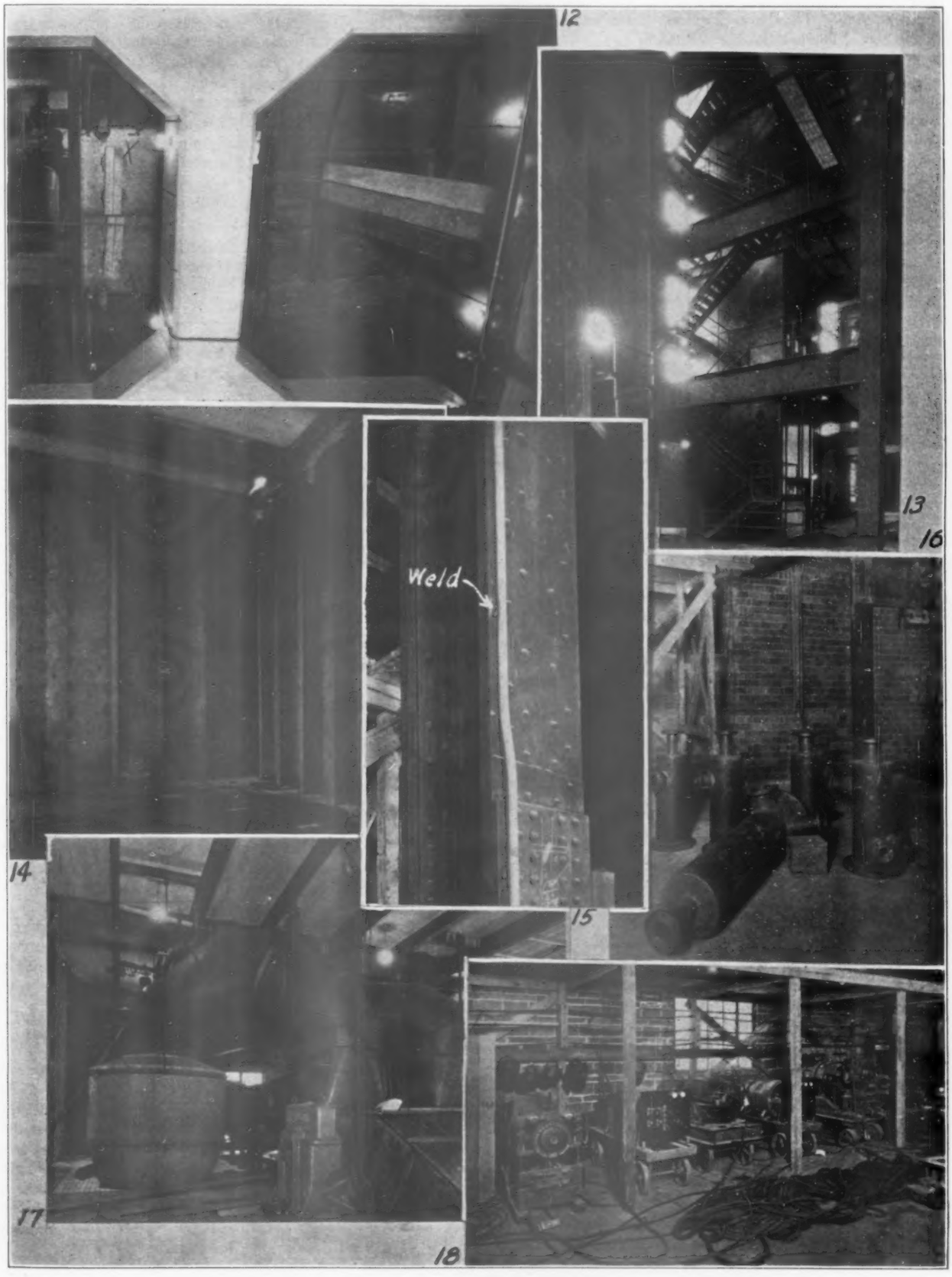
In the recognition of welding as a new art, the first step towards its successful application is taken. The placing of quality before economy and the enforcement of rigid supervision and inspection during the actual welding operations, are vital and necessary factors. Recognition of the fact that in welding all men are *not* equal, and the placing of operators on work suited to their ability, help to make for success. Judging the individual's ability and using it where best needed will save many welding jobs from failure.

It was through the application of these principles that con-



fidence in welding was restored. The photographs are indicative of the wide variety of work to which welding machines at present are being put by the Detroit Edison Co. Figs. 2, 4, 8, 9, 16 and 18 are used through the courtesy of the McGraw-Hill Co. The following paragraphs are descriptive of the views shown:

(Fig. 1) In 1925 the first electric welded gas main was laid by the Gas Division of the Detroit Edison Co. It consisted of about four miles of 8-in. pipe, butt welded every 40 ft. In 1926, 15 miles of welded mains was laid, and during the next two years 75 miles of pipe from 4 to 8 in. in diameter was installed. An additional program of 80 miles of welded mains



was completed in the first eleven months of 1929. This pipe is received from the manufacturer beveled to a 45-deg. angle, and the fittings are made up and welded in the field as needed. The two Fordson-driven units already referred to are used for this work.

(Fig. 2) The adoption of welded stairways and handrails has resulted in savings of over 50 per cent. The stringers, hangers, landings, treads, etc., arrive at the job ready for erection and welding. They are practically standardized as to length and size. The handrailing is brought to the job in 20-ft. lengths, marked by templets, cut with a cutting torch, and welded in place. In the new Delray No. 3 power house, now in course of construction, approximately 20,000 ft. of welded handrailing has been installed, and an equal amount has been installed in other plants and substations of the Detroit Edison Co.

(Fig. 3) The electric-welded economizer casing, partitions, ducts, and uptakes on boiler No. 13 in the Trenton Channel power plant showed a saving in material and erection over the old method of riveting and caulking and proved to be a more efficient installation, cutting the loss of air from 5 per cent to ½ of 1 per cent.

(Fig. 4) The steel partitions for switch compartments in the new Grand Ave. substation, as well as in several other substations, are now electric tack welded of plate steel, angles, and tree irons, instead of being constructed of concrete as formerly.

(Fig. 5) This view shows the ventilating ducts on the roof of the McGraw substation when the job was half erected. Twenty-eight tons of steel plate was used, all arc welded. A similar job is being erected at the Walker substation and two jobs of 80 tons each at other locations.

(Fig. 6) Fifteen all-arc-welded steel circuit-breaker switch cells, weighing about 8 tons each, are being installed at the Waterman substation. At the Cortland substation, where the first cells of this type were installed, 42 cells weighing over 300 tons have been placed in use. All these cells are welded gas tight.

(Fig. 7) In the Beecher Ave. welding shop ten welding units are in use, working two shifts. The switch cells shown in Fig. 6 were erected and welded here. Structural and miscellaneous welding of all kinds of equipment is done here.

(Fig. 8) In the general-service heating lines, exhaust-vent lines, and compressed-air lines in the new Delray No. 3 power house, over 400 joints of 4, 6, 8, and 24 in. pipe have been welded. The 4 and 6 in. pipe was beveled 45 deg. before welding and a 60-deg. bevel used on the larger sizes of pipe. The joints were opened 1/16 in. and butt welded. The highest pressure carried in any of the welded pipe lines is 100 lb. per sq. in. The main steam line is not welded. All elbows, nipples, etc. are made up and welded on the job. This illustration shows turbine pipes.

(Fig. 9) This welded elbow is in a 24-in. vent line.

(Fig. 10) These ducts are an all-welded job of 10-gage material completely fabricated in the Beecher Ave. welding shop and transported in sections to the Delray No. 3 power house where they were erected. The layout and punch-press work on this type of job results in very great savings in cost. The completed job has a smooth finish, and the rigid construction is much superior to the riveted type.

(Fig. 11) The smoke uptakes for the five boilers in the Delray No. 3 power house require 30 tons of welded steel plate, all being 3/16 in. thick, except the expansion joints which are of ⅛-in. plate. This job is arc welded, and smoke and dust tight.

(Fig. 12) This air chamber is on No. 11 and No. 12 turbines in the Delray No. 3 power house. This cooler required 23 tons of 3/16 and ¼ in. plate, stitch-riveted, with 12-in. centers, and is arc welded air tight. This job contains 1,341 linear feet of welding, mostly vertical and overhead, and was welded for $250. No. 12 turbine is an exact duplicate of No. 11. Owing to the concrete turbine base, no better view than this could be obtained.

(Fig. 13) The freight elevator in the Delray No. 3 power house is enclosed with a tack-welded casing about 7x10 ft. and 140 ft. high. The stairway and the handrail which parallels it are also all welded.

(Fig. 14) This is an interior view of one of the three arc-welded water-storage tanks in the Delray No. 3 power house. Each tank is 28x16 ft. and 15½ ft. high, and is equipped with safety ladders and other appurtenances. Each tank has 2,300 linear feet of welding. No corner or bottom angles were used. The plates overlap and are welded inside and out.

(Fig. 15) The welding of house service conduit to columns and other supports is a recent development. This does away with drilling and tapping for the conduit clamps and results in large labor savings.

(Fig. 16) These hotwells for the stage heater of No. 11 turbine are completely welded.

(Fig. 17) The dust-collector system in the Delray No. 3 power house is made dust tight by welding.

(Fig. 18) A few of the 60 welding machines in use by the Detroit Edison Co.

WELDING AND CUTTING NOMENCLATURE, DEFINITIONS AND SYMBOLS

A bulletin of welding and cutting nomenclature, definitions and symbols is published as a supplement to the Journal of the American Welding Society. This bulletin has been under preparation by the American Welding Society for the past three years and because of its fundamental and comprehensive nature, it represents one of the most valuable underakings of the Society to date. This is especially true at the present time on account of the tremendous increase in the use of welding and cutting, and because it has become increasingly difficult to obtain a clear conception of the ideas expressed by various authors due to the diversified terminology which has already crept into use through a lack of standardization.

The text, exclusive of the index, consists of 43 pages, with numerous cuts. It is divided into four sections. Section I covers nomenclature; Section II, definitions of general welding terms, processes, forms of joints, forms of welds, and equipment and supplies; Section III, abbreviations, and Section IV, symbols.

Under Nomenclature in Section I, the names of the principal welding processes are given in full, and there is a schematic diagram of the principal welding processes illustrating graphically their inter-relation. The definitions in Section II and abbreviations in Section III are profusely illustrated so that there can be no misunderstanding of what is meant. Finally the symbols in Section IV are for use in connection with the resistance and fusion welding processes.

A copy of these standards should be in the hands of every engineer, designer, contractor, welding foreman, and indeed anyone using any of the welding processes, as they will be invaluable aid in their work.

ENGINEER GETS CONTRCT BY RECOMMENDING A WELDED JOB

A well known Cleveland engineer reports that his firm was requested to bid on a big power installation recently. For some reason the specifications read: "Entire galvanized pipe installation." The engineer realized that welded pipe installations were ideal and knew that black iron pipe welded on this particular job would be superior to what the contractor thought he wanted. Consequently he approached the firm and showed them the welding on all welded installation was possible on black pipe, but not on galvanized and secured the contract for an all welded black pipe installation.

Spot Welding Aluminum*

Electrode Points of Special Design Aid in Concentration of Energy and Make Uniform Welds—Tests Indicate Quality of Welds Is High

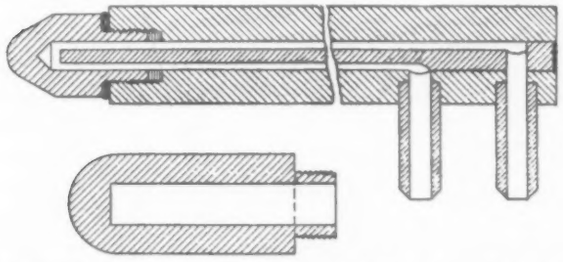
By W. A. Dunlap†

AN extended investigation of the subject of spot-welding aluminum and its alloys has been made in the laboratory of the Aluminum Co. of America, New Kensington, Pa.

Early in the investigation it was realized that it would be necessary to establish a standard of comparison so as to be able to tell whether a good weld was obtained. It was established that the best spot weld is one which pulls out of the welded sheet so as to leave a hole. Such welds can be made in pure aluminum and the alloys 3S (aluminum-manganese), 17S (duralumin), 25S (aluminum-copper-manganese-silicon) and 51S (aluminum-magnesium-silicon). The method referred to serves as a rough test of the quality of the weld.

A spot welder with a rated capacity of 20 kw. was used in the investigation. It had a five-point switch for controlling the secondary current, and a spring and adjusting nut for controlling the mechanical pressure applied to the work between the electrodes while welding. The length of time that current is applied is determined by the rate at which the treadle of the machine is depressed.

It was found early in the work that an electrode is required which does not alloy readily with aluminum. Neither the plain copper electrodes nor patented types on the market proved satisfactory. Copper readily alloys with aluminum, and the copper electrodes soon become covered with a layer of copper-aluminum alloy, after which the quality of the welds produced

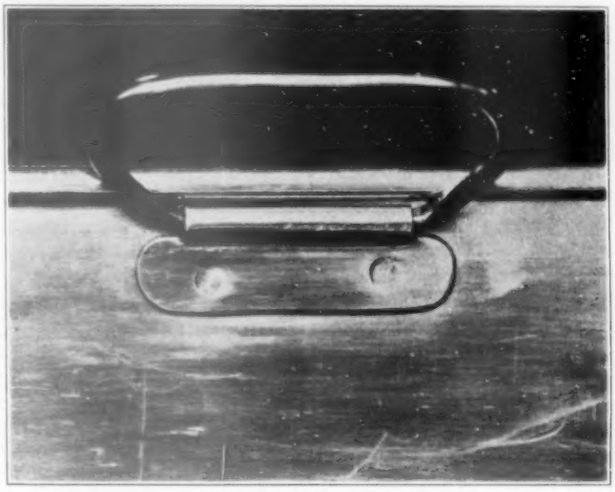


Water Cooled Electrode with Welding Tip, and Special Hemispherical Tip.

is very poor and there is great danger of burning a hole in the sheet due to arcing.

In considering the problem, the opinion was formed that chromium would be a good material for electrodes. Its melting point, 2,800 deg. Fahr., is nearly 1,600 deg. Fahr. higher than that of aluminum; it is a slightly better conductor of electricity than aluminum, and it does not alloy readily with the latter metal. Furthermore, chromium is hard enough not to lose its shape under the pressure applied in welding. Chromium, at the time, could be obtained only in ¼-inch rods, and an attempt to tip some of the copper electrodes with lengths of this rod showed that it was too brittle to work with. A number of copper electrodes were then chromium-plated, and with these in the machine the daily production on a piece requiring 15 spots for assembly, was increased from 5,250 with copper electrodes, to 10,500 spots. On 2S and 3S metal from 2,500 to 4,000 spots can be made before the electrodes require dressing and replating.

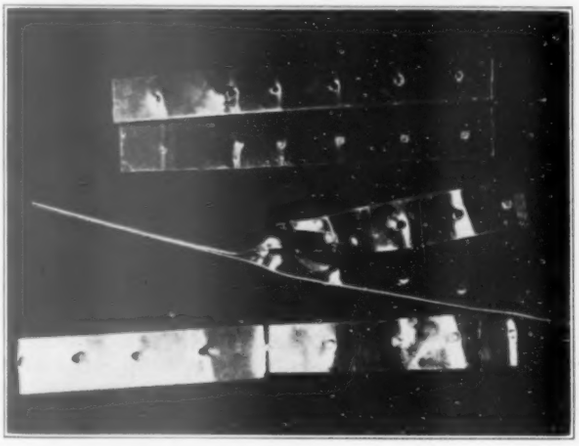
The electrodes are made of 1-inch copper rod, the welding tips being rounded to a radius of ¼ inch. With this electrode a dished spot is produced in the sheet, but if pressure and current density are correct the depression is not deep enough to be objectionable. It was found that this gage sheet (0.010-0.020 in.) which it is almost impossible to weld with



A Spot Welded Joint in an Aluminum Cooking Utensil.

flat-tipped electrodes, can be readily welded with these electrodes with hemispherical tip. With the flat tip it is impossible to insure uniform distribution of pressure over the whole surface of the tip; this results in concentration of current and an uneven "spot." The electrodes are drilled to within ½ inch of the contact surface, and water is circulated through them.

The three factors which affect the quality of the weld obtained are the current strength, the length of time the current



Spot Welds in 0.064? 3SO Sheet Showing the Manner in Which Good Welds Should Fail.

is allowed to flow, and the mechanical pressure applied. These must be varied until satisfactory results are obtained on any given job. In working out the conditions for spot-welding a particular thickness of metal, the best general rule to follow is to employ a high current and as low a pressure as is possible without danger of arcing. The following table of currents

*Extract from a paper read before the American Welding Society, Chicago Section, October 3, 1929.

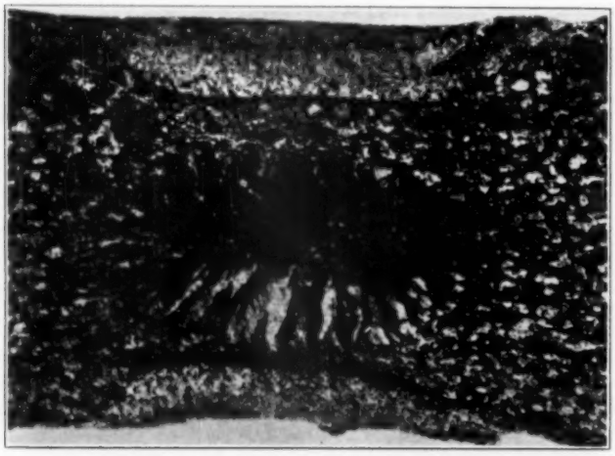
†Metallurgical Engineer, Aluminum Company of America.

across the electrodes and mechanical pressure for different gage sheets gives some idea of the requirements:

Metal	Thickness of Sheet, In.	Amp. in Secondary	Pressure in Lb.
2S	0.020	4700	80
2S	0.030	5900	
2S	0.040	6800	80
2S	0.050	7600	90
2S	0.060	8500	90
3S	0.020	4800	95
3S	0.040	6000	80
3S	0.060	6800	85
3S	0.080	7500	95
3S	0.100	8100	100

All aluminum is covered with an oxide film, but in the case of 2S and 3S this is very thin and does not interfere with the welding process. On the other hand, the fairly heavy oxide film on the heat-treated alloys 17S, 25S and 51S calls for special treatment. The oxide film is of very high resistance, and if a voltage high enough to break it down is used, the metal quickly overheats, causing it to melt and form blowholes through the material before the current can be shut off. When the film does not cause blowing, the welds have oxide inclusions and are brittle and weak. The oxide film has practically the same effect on the weld as the presence of thin films of oil or paint. It is possible to spot-weld aluminum through such films, but heavy mechanical pressure is required. In general better results are obtained by first cleaning the metal, either by abrasion or by dipping in caustic, this first dip being followed by another in nitric acid to neutralize the caustic adhering to the metal.

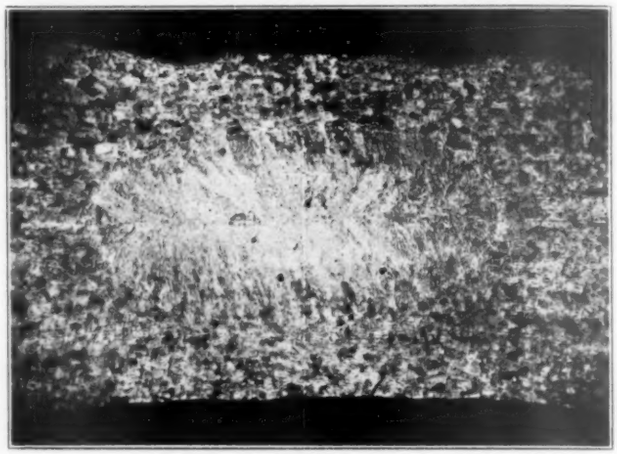
Spot welding is similar to riveting, and the strength of welded joints may be expressed in the same terms as that of riveted joints. Considerable variation in strength was found



Micrograph of Section of Two Sheets of Aluminum Spot Welded Together. (Crystal structure of metal unaffected by heat of welding, depressions on surface of sheet caused by electrodes, and crystal structure in the weld. The metal has melted and run together, forming a continuous union between the two sheets. 2SO metal, 50 dia. magnification.)

when specimens were subjected to tensile tests. Owing to limitations of the testing equipment, all of the tests were made on strips of 1 inch width. Two strips were welded together end to end, with either one, two, three or four spots. Some strips of 2SO flat sheet, 0.050 inch thick and 1 inch wide, were welded together with a single spot. The material of the strip has a tensile strength of 13,700 lb. per sq. inch and it was found that the weld had an average strength of between 250 and 260 pounds, making its strength about 38 per cent of that of the strip itself.

In the case of two-spot joints the average strength was 420 pounds, or 63 per cent of that of the strip. In the case of three-spot joints, the average strength was 561 pounds, or 84 per cent of that of the strip. The three spots were placed at the vertices of a triangle with one side parallel to the end of the strip. With four spots the joint was found to be stronger than the strip. All these results apply to the 2SO alloy. In practical work the spots can be spaced according to the strength required in the assembled piece. A photomicrograph on an etched section of a weld showed that the



Longitudinal Section of Spot Weld in Two Pieces of 51SW Sheet. (50 dia. Magnification.)

metal at the joint had completely melted and metal from the two sheets run together. The structure of the metal in the weld area was typical of that of a chilled casting.

It was found that aluminum alloy of one composition, like 2S or 3S, for instance, can be welded to an alloy of different composition, like 17S, 25S or 51S. With the machine used in this investigation, the maximum thickness of alloys 2S and 3S that could be satisfactorily welded were found to be 0.064 inch and 0.120 inch, respectively. The maximum thickness of the other three alloys was found to be 0.064 inch. This applies to two pieces of the same thickness. However, one sheet may be much heavier if the other is very light. For instance, 0.040 inch sheet may be spot-welded to ½ inch stock. Three or more sheets may be spot-welded together, the thickness of the heaviest piece and the number of pieces being limiting factors. Wrought sheet may be welded to castings.

It was found that the spot welding characteristics of the sheet are independent of its temper and that the temper of the metal surrounding the weld is not materially affected by the heat of welding. Brinnell impressions made on a strip of 51SW at ⅛, ¼, ½, 1 and 2 inches from the edge of the weld gave the following hardness numbers, respectively: 55, 60, 65, 65, 65. The normal hardness of this material runs from 55 to 70.

Practically all of the work was done on the 2S and 3S alloys, and only enough on the strong alloys to show that they are not materially different in their behavior during welding. However, in welding the strong alloys it should be borne in mind that a portion of the point of weld melts and solidifies, assuming the structure of a casting, and the stronger alloys in the cast form have relatively small elongation. Such welds should not be used where the joint is subjected to considerable vibration. It has been found that the spots are clean and sound, and that with proper control of current and electrode shape good spots can be obtained consistently.

The great advantage of spot welding lies in its cheapness. It accomplishes in one operation the same end which is accomplished by riveting in three or four operations(piercing, countersinking, inserting the rivet and driving, to say nothing of the cost of manufacturing the rivet). The spot-welded joint is practically as strong as the riveted joint and contains no crevices or corners difficult to clean, nor can it become loose after a period of service. The spot weld, even if it does stretch, is integral with the parts and cannot possibly develop any play.

Gas Welding in the Structural Field

Improvements in Economies and Quality of Structural Gas Welding and Cutting Are Possible by Giving Attention to Fillet Sizes, Procedure, and Testing

By H. H. Moss†

FROM a welding engineering viewpoint, oxy-acetylene welding of structural steel should be considered as a development problem of detail application in classification of low carbon steel, rather than a new adventure of the oxy-acetylene industry, as the laymen to this art may be inclined to regard it.

You have heard it said—

"They are now trying to weld structural steel by the oxy-acetylene process."

Structural steel to the gas welder is low carbon steel, the welding of which he is very familiar with, for he has been welding this class of material ever since the inception of practical welding operations. His experiences in working with this class of material constitutes the largest working background in the gas industry's welding activities. Therefore, in applying gas welding to structural steel we are merely extending the range of this method of construction within a field in which it has been extensively used for many years.

Gas cutting of structural steel is gradually assuming a position in the structural steel industry similar to that which it has attained in other industries working with carbon steels, where it has supplanted other means for severing and fashioning the heavy gauge materials.

The many applications which have been made with these welding and cutting tools have not come into being purely as result of manual ingenuity. The gas industry's technologists, especially its metallurgists and physicists, have been at work analyzing the various problems of welding and cutting which their field associates have encountered.

Specification Welding

Innumerable examinations of welded specimens taken from field operations have been made for the purpose of finding out whether the methods employed in the field for their production combined the essentials which modern practices and research have determined to be necessary for welded construction to meet the requirements for strength, ductility, denseness, etc. The result of these studies has lead to "specification welding" in contrast with the older practices, which more or less put the job "up to the welder." Coincident with this work, a search was made for better welding rod materials, such as would provide a weld having properties closely approaching, or better than those of the base metal in which they would be used. The result of the research in this direction has provided a number of improved rods, several of which have already found wide usage in construction. Excellent weld quality and strength have been obtained therefrom and an increase in rate depositing, which has reduced the cost of making a weld.

Scientific Cutting Data Available

Research work has also been done on gas cutting. Studies have been made of the effect of cutting on carbon steels, such as its influence on the metal immediately to the cut surface, and the alteration in physical properties which this influence may have caused. The findings of these investigations have been published. They show clearly that if properly applied, oxy-acetylene cutting does not alter the strength of low carbon steel in the region of the cut to an extent that will ever prevent its being serviceable for general building construction purposes.

The cutting blowpipe, however, is not intended to be used as a chopping tool. For construction and production work it is intended for smooth linear severing at definite rates of travel and with definite sizes of cutting flames for varying metal thicknesses and anything other than this is not within the recognized scope of this tool for such purpose.

In short, there has been made available to the field a large and varied amount of scientific data on welding and cutting of low carbon steel, which the welding engineer and supervisor is putting into every day use, in solving construction problems.

In undertaking to commercialize welding and cutting of structural steel by the gas process, we are undertaking to find means and ways of utilizing tools of proven technical work in competition with the older practices of fabrication and the attendant manual dexterity developed by the craftsmen functioning under these older practices.

Speaking of structural gas welding, there have been two things which have served as handicaps heretofore to a wider application in general building construction. One of these, which is more or less confined to fabrication or the shop end, has been the belief that you cannot gas weld shapes without having considerable warpage.

The other has to do with the economy of certain applications of fillet welding wherein the cost of deposition in many instances has been somewhat excessive.

These two matters have recently been given considerable study.

Warpage Not a Prevalent Characteristic

As regards warpage, the work of this past year in welding in the major class of structural framing has provided opportunity to observe warpage effect over a wide range of conditions and it has been found that warpage is not a prevalent characteristic. It is confined to connection details between ends of members and its control is a matter of designing so that the forces set up by localized heating are balanced with respect to the center of gravity on the section being welded.

Experience in welding the heavy shapes has demonstrated that as the mass of the part increases the warpage effect decreases. A practical demonstration of warpage control in a structure of good size may be seen in the welded Research Building erected at Niagara Falls this year. The alignment of the welded steel in this job, which contained approximately 300 tons of miscellaneous steel, was excellent and was accomplished, with but few exceptions, without corrections subsequent to welding.

Fillet Welds

With regard to fillet welds, their use in structural welding is essential to a general design conversion. This type of weld has much to recommend it. It is most commonly used in direct shear wherein resistance is developed by a columnar plane

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of metal parallel with the applied force or load. Slight defects in this type of weld are seldom the focal points of rupture when testing fillet welded specimens to their ultimate strength. In modern welding practices and with high test-welding rods, the gas fillet weld has a high strength value both as regards tensile strength and ductility. By gauging their size with no **under** tolerance the commercial weld has, at any point throughout its length, a minimum strength value approximately equal to the ultimate shearing strength of the design section. This practice of full gauging operates to insure a certain amount of reinforcement of all fillet welds throughout the job.

From the standpoint of economy of fillet welding, there are several points to observe; first, it is necessary to reduce the blowpipe preheating time to a minimum. This must not be confused with the general term which implies the preheating of a whole part, such as in the practice of welding castings. It refers to that period of time wherein the welder plays the welding flame upon a localized area about the starting point of the weld to bring its temperature up to the melting point. In design of connections it can generally be arranged so that the welds are not placed in areas of concentrated base metal such as flange and web junctions. Such placing operates to increase the rate of welding all along the line or to increase the tonnage per welder per day without increase in gas consumption.

Size of Fillet

Further economy can be obtained through proportional selection of fillet weld sizes. As the parts increase in thickness or mass, a corresponding increase in heat input is necessary to bring the surfaces to be welded to the melting point with a resultant larger area under welding heat. Larger welding flames are employed to supply the greater amount of heat needed and in turn this and the greater heated area bear an influence on the size of the weld. The point is, that, if it is necessary to provide heat that would accommodate, say, a ½ or ⅝ in. fillet weld, we are not taking economic advantage of this heat if we specify and design with ⅜ in., or smaller fillet welds than would normally be deposited for any given thickness.

The welder is inclined to make a weld in proportion to the conditions which he has to develop for proper fusion and therefore it has been found more economical to use proportional sizes rather than to adopt a single standard size for design in general. While the weight of metal in a fillet weld increases as the square of its base dimension, the cost of the proportional fillet is only slightly higher than that for a fillet of smaller dimensions for the welding reasons explained above. Economy is then obtained through a reduction in weld length by utilizing the strength of the proportional weld instead of the strength of a longer but lighter weld which may have otherwise been specified.

This leads up to a point in gas welding which has a considerable bearing on cost. It is over-reinforcement. In fillet welding, it amounts to increasing the factor of safety which the designer has regarded in his determinations. In butt welding, reinforcement beyond that recommended in the American Welding Society's Structural Welding Code, adds little to the strength of the weld and in single "V" welds over-reinforcement may show no increase in strength due to its eccentric position with respect to the center of stress action. If proportional fillet and standard butt welds have been specified there is no advantage in over-reinforcement.

Several Economics in Shop and Field

Our efforts towards improved economy in welding generally will be aided by carefully regarding the facilities which bolting affords. Bolting is deemed essential for safe and economic field erection and its use can often be extended to good advantage in members which must be punched at their end for erection purposes. Field welding can be employed in members where rigid field joints are specified, enabling a portion of the steel to by-pass the Welding Department of the fabricating shop. Shop welding is thus more or less confined to welding punched details, such as landing seats, web connections, splice plates, etc. to unpunched members, which can be delivered to the Welding Department as soon as they are cut to size. The work of detailing, laying out of templates and routing of materials is thus simplified.

Economics in welding are cumulative; they originate at the designing board through use of lighter members to sustain the loads and to secure the parts together, and follow into the Detailing Department. Template and Machine Shops, and in the handling of materials from stock through the fabricating shop to the point of loading for shipment. When estimating the probable cost of welded construction from the standpoint of a broad application, there is more involved in the calculation than the mere cost of depositing weld metal per ton of steel. The ultimate savings should be quite an appreciable percentage of present makeup costs.

To complete the economic picture there must be developed a uniform method for bidding on field or erection welding, where the work is divided between fabricators and erection contractors similar to the practices in riveted construction. While the ton unit cost is obviously to be preferred, there is not, nor will there be for some time, sufficient background of applied design and field experience to enable the use of the ton unit in bidding on field welding. Its use for riveted construction is the outcome of long experience and it rests upon a mass of classified detail cost data accumulated from cost studies of innumerable kinds of building structures Obviously similar studies are before us for welded construction pending its general adoption, whereupon the ton unit can gradually be substituted.

A Suggestion for Cost Computations

In gas welding it works out that the cost of depositing a pound of weld metal varies slightly with varying weld dimensions. This cost, being quite regular, a few classifications for minimum, average, and maximum dimensions and for welding positions could be worked out which would apply to the majority of conditions encountered in the field. Under this method, direct field welding costs could be obtained by extending the calculated inches of classified welds into pounds of deposited metal and multiplying by the cost of deposited metal per pound applying thereto. This method has the advantage of eliminating the detail calculations for gas, oxygen, and rates of welding from the Estimating Department, such being considered only by the cost accountant. The conversion of cost per ton, which must include service, supervision and indirect costs, can then be made up. By informing the job foreman of the estimated rate of inches per day per man, the field welding schedule can be readily checked daily from the quantity estimate sheet. Again, gas, oxygen and rod calculations are omitted except for field stock purposes.

The above method is one which the author's investigations have indicated would tend towards simplification of cost estimating and the obtainance of greater accuracy in arriving at field welding costs.

Control of Workmanship

Having data for proper welding design and procedures for economical deposition of weld metal, we proceed towards the second phase in structural welding, that which involves

workmanship and its control. Consideration of the practical aspects of structural gas welding will simplify the welding operations. In other words, we can design for gas welding and can thereby avoid the things that are out of balance from an operating point of view. The manual part of welding will then reduce down to the simple details of normal deposition. Our concern about this element in welding is to get full fusions of weld and base metal, sound metal in the body of the weld, and weld dimensions within reasonable tolerances, and the proper finish of the welds at their terminals. These are the requirements of construction welding and are the product of intelligent direction of the welders. Training courses and specific qualification tests have been carefully worked out for every kind of applied welding. These data are available in the form of training manuals and procedure controls. The industry through this means has developed thousands of qualified construction welding mechanics for various classes of work, and whose ranks are being increased as fast as the demand for them develops. In qualifying operators for structural gas welding, we must subject them to a range of welding, common to the structures they will be required to work on in production. This range will include varying thicknesses of base metal, butt and fillet types of welds and deposition in the flat and vertical positions and also the overhead position if overhead welding is involved. The average gas welder can be developed to embrace all these conditions readily. There is nothing complicated in any of these conditions and therefore, the designer has full privilege to dispose his welds in any manner that will operate to produce the simplest design or obtain the best economy. Generally speaking, though, the maximum of economy will obtain if the welds can be made in a flat or normal position. The main factor in the obtainance of good welding mechanics is the final qualification test. It subjects the welder to a series of tests which evaluates their workmanship by standard testing procedures. These tests are not expensive; they provide an impartial means for the determination of a mechanic's skill. It can be said that the practice of subjecting welders to rigid classified qualification tests has done more towards advancing construction welding than any other single factor.

The next subject in this second phase of structural welding is the problem which applied structural welding places on the shoulders of the regulating bodies responsible to the public at large for safe building construction. It is the work of the personnel of these bodies to see to it that all methods of construction are carried out in a sound and workmanlike manner and if they are to safeguard welded construction they must necessarily know when welding is properly done, or have at their disposal means that will insure to them that such is the case.

The general attitude of these bodies has been constructive to say the least. They have, with few exceptions, given special permission to use welding whenever it has been shown to them that it will be applied under the control and direction of engineers and architects competent in this work.

The interest which these bodies hold in structural welding has been manifested by numerous requests for information on the subject made to the welding industry and its official organizations.

Recently, the American Welding Society, through its Committee on Building Codes, has promulgated a Code for Structural Welding and Gas Cutting which the Society has presented to every Building Department on record in this country and Canada for their consideration. It covers the essentials for safe construction and its appendix matter defines in quite some detail the practices of welding which have been found by experience to give uniform safe results.

This Code was prepared in answer to many requests coming to the Society for such data.

Weld Inspection

A question, however, in the minds of many building officials and often asked is "How can you determine the soundness of welds after they have been made?" It is a logical question when we stop to consider that Building Inspectors cannot be on the job at all times during welding construction. While it is possible for an experienced welding inspector to judge with considerable accuracy the quality of a completed weld by a visual inspection, it is the author's belief that the time has not arrived where this means can be depended upon for general control of weld quality, even when presupposing that the welders have passed a qualification test.

For the answer to this question, may we not take a page out of the experiences of the welding industry in connection with the welded construction in high pressure piping systems, pressure vessels, aircraft, railway transportation equipment, refrigeration systems, and other important work, and analyze them for a workable means for regulating workmanship. Satisfactory results are shown to have been obtained through proper qualification of the operators, followed by *Live Inspection*, that is, inspection at the time the welding operations were under way. This procedure has many precedents in construction work. It is quite analogous to the means which the architect and engineer employ for structural brick work and concrete in important structures. The surface appearance of these materials is somewhat indicative of internal quality, yet such is not relied upon; instead, Live Inspection is demanded. Resort to Live Inspection for welding will not require the inspector to stand over each welder. Welders, like other construction mechanics, acquire uniform habits in making welds. It is only necessary on the part of the inspector to ascertain whether their skill is sufficient for the work at hand. Once this has been determined and the means for this have been standardizd, the inspector's job is a relatively simple one. He can look after a number of operators. This method of inspection suggests then that the Building Department consider the confining of their efforts mainly to the determination of the proficiency of the Live Inspector provided by others. Such procedure of inspection and its control would provide a double check on the quality of workmanship for it would seem to be entirely within the range of pursuit of a Building Department Inspector to visit any welded job under his jurisdiction and check at intervals the Live Inspector's performances and the detail operations of the welders.

The working details for the qualification of Live Inspectors and for acquainting the general inspectors of the Building Departments with the practices of sound welding, could be undertaken by an official group representing the responsible designing, regulating and inspection bodies involved.

The Stethoscopic Test

Following closely on the heels of the practical demonstrations of structural gas welding and particularly the inspection phase of this work is an endeavor to develop a means for non-destructive testing of welds. The efforts in this direction have already borne fruit in a means which puts to use an instrument similar to the physician's stethoscope. At two recent sessions of the American Welding Society representatives of the Carbide & Carbon Research Laboratories, Inc., demonstrated the application of the stethoscope in detecting flaws in welds, one of these demonstrations centering on the structural fillet weld. The difference in the sound vibrations emanating from so-called good and bad welds resulting from light hammer blows was very marked, leading to the belief that this method may be entirely feasible for non-destructive evaluation of finished welds. If so, the building inspector will have a further means at his disposal for checking the soundness of welds during his periodic visits.

The scope of this subject goes further to involve the work of inspection of welding and cutting in the fabricating shop. This is as essential as the field inspection and it would seem feasible for the Building Departments to require the certification of the shop work by a qualified inspector.

The ground work for this service was laid some years ago for welded pressure vessels and welded steam power plant piping and the experiences accruing out of its development would, no doubt, be of great value in planning the means for this phase of welding inspection.

Use of the Cutting Torch

Referring again to the practices of gas or flame cutting of structural steel, while on the subject of inspection, there are two distinct classifications in application. One deals with the operation of cutting as a means for the preparing of edge metal for a subsequent welded joint wherein the cut surface is later involved in the weld. The other deals with the operation of cutting as a means for fashioning structural materials to the dimensions and configurations called for in the designs. Both operations should be done in accordance with the recommendations in the Code of the American Welding Society. However, for the latter classification, the tolerances are necessarily much narrower and the contour of the cut about the vertex of re-entrant angles should form a fillet. Re-entrant cuts at the vertex should be avoided as in other cutting practices as they offer opportunity for premature detail cracks due to a concentration of stress at such points. The cut edges should be smooth and regular, which is the result when the blowpipe is guided by a straight edge. Lastly, it is important to use the proper size of cutting nozzle so that the metal is not unnecessarily preheated beyond the temperature required to maintain the cutting operation. A good cutting speed is beneficial to both surface finish and the base metal properties in the narrow region immediately below the cut edge.

Broad usage of gas cutting in the structural steel field, such that will envelop the entire field, seems to be merely a matter of developing portable profile machine cutting tools that will avail to the structural steel industry for their purposes the facilities and workmanship which have been provided to other industries working in carbon steel. The accuracies and finishes in modern machine gas cutting practices would seem to have a very important meaning to the fabricators aside from the matter of economy.

In the development of new processes of joining construction materials, it has always been found advantageous and necessary to illustrate for the benefit of the general construction industry, the worth of these processes in terms of either the ultimate strength or a suitable strength when applied to the usual forms of detail for which they are recommended.

Need for Additional Testing

With regard to construction welding, a number of our larger concerns have undertaken detail tests for their personal satisfaction. Some of our colleges have also undertaken to do work of this character though largely confined to welds rather than connection details. These tests have provided much of the background for our present practices. There is an apparent need for additional proof testing of standard structural connections preferably at the hands of non-commercial testing organizations. Data brought out under such auspices have been spoken for by many engineers and architects. The author brings up this matter for your consideration as one which he feels will do much towards furthering the adoption of structural gas welding.

With a reasonable time the work of the Structural Welding Committee under the American Bureau of Welding will be reported. This Committee has been working out one of the important initial problems in connection with the general application of structural welding, that of obtaining a cross sectional evaluation of welds common to steel framing used in buildings made at the hands of representative fabricating shops under carefully devised specifications. The completion of this program is looked forward to with much interest as it will not only provide a mass of general welding data but aid greatly in the shaping of plans for further development work.

In the meantime, additional practical cases are being studied by the Company with which the author is identified for immediate construction, thereby to extend the scope of gas welding experiences and provide further demonstration of the feasibility of this process as a safe and economical commercial tool for structural steel fabrication.

Conclusion

One working in this branch of welding is impressed with its scope. The subject is one which has an unlimited range of possibilities, not only from the standpoint of its practical use as a tool for joining parts together but also through its bearing and influence on general methods for design and production of steel frames. The supporting structures of buildings of the future may be different in many respects from what they are today due to the facility which welding provides in constructing steel materials.

The noiselessness of welding operations will, no doubt, have a very important bearing on future construction. Its economic aspects encourage investigations looking forward to entirely new forms of construction in competition with other or more tedious methods. Its utility in unusual constructions is not the least of its desirable features and should attract the attention of architects in the working out of design motives involving intricate assemblies of steel.

The dissemination of data covering the rudiments of safe design and economic application is our present job and in this endeavor we should not underestimate the assistance which can be had at the hands of responsible fabricating interests.

PIPE-WELDING DEMONSTRATED AT CHICAGO MEETING OF A. W. S.

An actual demonstration of the cutting and welding of a length of 6-in. pipe was staged at the recent meeting of the Chicago Section, American Welding Society, held on December 6, 1929, at the Palmer House. Other practical demonstrations are being planned for future meetings of the Chicago Section.

Another feature of the December meeting was the representation of an applicant for a welding job being quizzed by a heating contractor to whom he has applied for work. Fred Outcalt, of the Linde Air Products Co., took the part of the contractor and E. S. Brewer, of the Air Reduction Sales Co., was the applicant. The questions, which were all of a practical nature, together with the answers, served to give contractors and welding superintendents an idea of the knowledge and experience that they should expect of their men, and to acquaint the welder with fundamental knowledge that he should have. The questions pertained to oxy-acetylene cutting and welding apparatus, types of welds and how they are made, welding pipes and fittings, and safety practices.

The welding demonstration followed, the applicant cutting the pipe in two and making a position weld with the torch. The cutting torch was then used to cut coupons out of the pipe, which were tested by bending in a vise. A great deal of interest was shown in the welding and testing.

Weld Tests Simplified*

With Modern Testing Equipment It Is Not Difficult to Make Convincing and Scientific Investigations of Weld Quality

By F. G. Tatnall†

FOR some reason or other, testing is regarded by the average engineer as a mysterious art, to be avoided wherever possible. It often seems too involved to be undertaken without long study of the subject. Yet as things stand today, testing is one of the very best friends of the welding engineer. It is an agency which can do more than anything else to help create public confidence in the art, and it is the surest check on human fallibility in this very human line of work. This needs no further discussion. Fortunately those who devote all their time to the improvement of

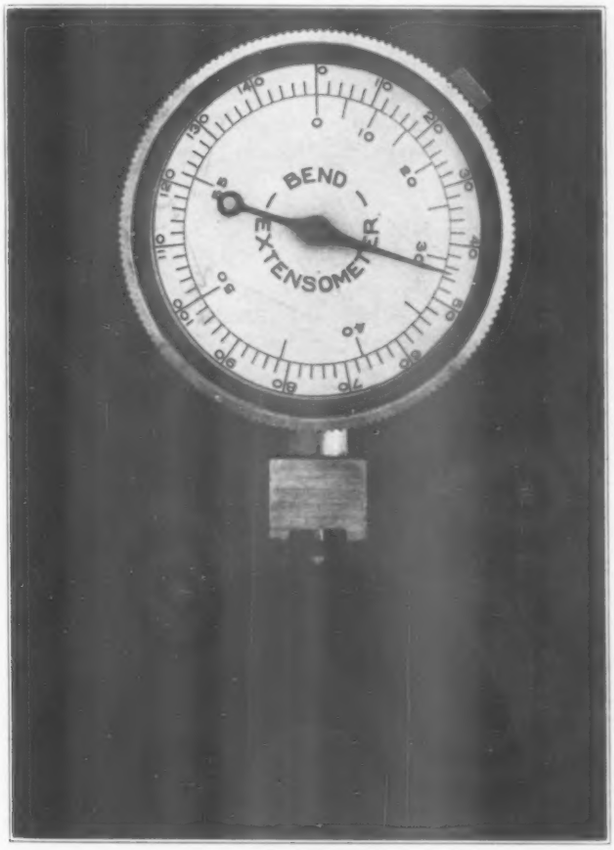


Fig. 1. The Bend Extensometer.

testing equipment and the simplification of testing methods, have been busily at work making the business of testing easier and less complicated until it can be a part of every engineer's daily work without great study and practice.

Inspection and testing are two different things. Inspection depends upon the personal judgment and experience of the inspector. The inspector's main equipment is his own keen sense and knowledge. Testing, on the other hand, is an exact operation, employing mechanical equipment as precise as can be devised. So, therefore, in writing of testing I at once divide the field of control in half and eliminate visual inspection in this discussion.

In welding work, the use of equipment is confined to a few very straightforward tests so there is no need to anticipate confusion in a multiplicity of technical rules. There are three main tests to consider: the tensile test, the bend test, and the test of the welded structure itself for stress distribution. All the volumes of literature on testing and procedure may be handed over to the technician who specializes on that sort of thing—they are not needed.

The Tensile Test

In taking up the three tests in the order of their importance, the attempt here is to reduce each to its lowest terms. The tensile test can be made to yield the following information: elastic limit, yield point, ultimate strength, elongation, and reduction of area. In testing a weld, why bother about anything but ultimate strength? The other properties, elastic limit, yield point, elongation and reduction of area practically always appear in the base metal or as a composite of both the weld and base metals so that no quantitative results are obtained. Since we are not here concerned with the properties of the base metal the only thing we want to know is how much strength will the weld develop? With nine-tenths of the technology of tension testing thus eliminated, we find happily that the latter is the easiest quantity to obtain with a testing machine. Ultimate load is that value at which the pointer, moving across the dial face on a hydraulic testing machine, ceases to advance and instead begins to retreat leaving a red maximum hand to show the load. On a lever machine this same point is found to be that beyond which the beam will no longer balance, and so the poise stands at ultimate load.

The Bend Test

The bend test shows ductility but not ultimate strength of the specimen weld. For this reason it should be used in conjunction with the tension test in the laboratory because the ductility of the welded joint is important and should never be totally neglected in a complete test of a weld. It has been a test lacking standardization or any real understanding in the past, yet it has all the earmarks of a test which cannot be dispensed with. The methods of the bend test have ranged from holding a specimen in a vise and bending it over with a hammer all the way up the scale to the employing of a costly special cold bend machine to bend the specimen around a pin of a carefully specified diameter, the pin diameter being a function of the dimensions of the specimen.

We heartily subscribe to a bend test procedure offered by Mr. Kinzel of the Union Carbide and Carbon Research Laboratories. He has simplified the test, and, in the process of simplification, has simultaneously increased its value. He eliminates the cold bend machine with all its rules and regulations and treats the specimen as a little column in free bending, using the compression side of the same universal testing machine in which he makes his tension tests. The specimen is first slightly bent at the end outside the testing machine and then bent back upon itself by the machine. Fiber elongation may be measured by change of distance between gage marks on the specimen. Mr. Kinzel has devised a special bend extensometer (Fig. 1), which quite simply reads the percentage elongation of the outer fiber directly.

† *Manager of the Testing Equipment Division of the Southwark Foundry & Machine Co., Philadelphia.*

* *Presented at Fall Meeting, A. W. S. Cleveland, September,* 1929.

Measurement of Stress Distribution

All the volumes of literature on this subject can be boiled down into the following simple rules for those who intend to measure stress distribution in welded structures.

Stress is related by strain by the elastic modulus, which can be taken as 30,000,000 for all this kind of work.

Strain can easily be measured by strain gages so that stress is finally determined from the above relationship, by

Fig. 2. The Laboratory Testing Machine and Electric Recorder.

multiplying the strain readings by 30,000,000. With modern strain gages stress can be thus determined within 500 lb. per sq. in. of the actual value, which is pretty good.

Stress studies in structures are obviously important in more ways than one. Studies are being undertaken everywhere nowadays and they are yielding some very good information on welded structures, pressure vessels, pipe lines and the like.

Testing Methods

a. The Portable Testing Machine.

Returning to the tensile test, this can be made in the field as well as in the laboratory.

A portable tensile testing machine of 40,000 ton capacity has been developed by Mr. A. B. Kinzel of the Union Carbide and Carbon Research Laboratories. This machine resembles a small oxygen gas cylinder in shape, size and weight. It can be transported and handled as readily in the field as a gas cylinder and yet it is a reliable testing instrument. It is entirely a self-contained unit with built-in pump and the load readings taken on a dial gage with much improved characteristics. The dial is carried in a separate box and screwed into its receptacle on the machine. This dial gage is of the Bourdon Tube Type. The Bourdon Tube Gage of past years has well deserved a very bad reputation, but this does not mean that a reliable gage using the Bourdon principle could not be built. On the contrary, sensible, conscientious development and research accompanied by the spending of some real money on the job has produced a Bourdon Tube Gage which is a precision instrument as accurate and reliable as could ever be desired, and which comes as a great surprise to those who have had experience with the old gages.

The specimen is brought up for test. This may have been cut from a welded pipe line joint, or from a structural weld, or it may have been one of the periodic sample welds made by the welder during the course of his days' work. The specimen slips into the little grips easily, using the fingers to spread the jaws. A few quick strokes of the pump handle and the load starts up the scale, leaving a red maximum hand at the ultimate load, whereupon the broken specimen is removed to make way for the next.

b. The Laboratory Testing Machine.

This kind of testing machine is larger and more elaborate than the portable field machine, for it is built to cover a wider range of usage with greater precision. The laboratory machine is only allowed a 1 per cent maximum accuracy as against a 5 per cent outside allowance for the field machine. To gain this precision the laboratory machine must have a weighing system entirely separate from the loading system, and on the hydraulic machine large precision dials must be used. The laboratory machine must have a motor driven power development unit under delicate control. Fig. 2 shows a laboratory machine of the hydraulic type with its large dials, but the main element of the weighing system is concealed in the base of the machine. The motor driven pump is an ingenious affair consisting of several little cylinders rotating about the main drive shaft and the discharge from these cylinders is varied by controlling the eccentricity of a floating ring. By such device, positive, non-pulsating flow to the power cylinder is obtained as

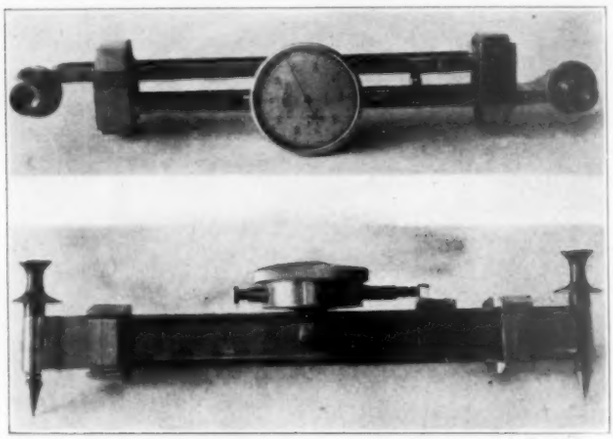


Fig. 3. A Hand Strain Gauge, 12 Inch Length.

well as excellent hydraulic speed control. The whole machine is self-contained and requires no foundation, and although it can be moved about it is not classed as portable.

The lever type machine has been so widely used for so long that it hardly needs description except to state that the load is applied through a gear train and a screw power press mechanism, with speed changes obtained through a gear shift. The load is weighed, not on a separate hydraulic weighing system, but by a large lever system, which in reality is a heavy-duty scale. It is larger and heavier than the newer type of hydraulic machines of the same capacities and it is also very reliable and simple in construction.

c. Recording Equipment.

The machine shown in Fig. 2 is equipped with the new electric recorder. There is an electric telemeter pressure transmitter installed in the weighing system and connected in circuit with a Leeds and Northrup Potentiometer Recorder, which is a familiar instrument to most engineers. A wide strip chart advances in proportion to the stretch in the specimen under test, while a moving pen actuated electrically makes a continuous and accurate record of the load curve. It is a very good thing to thus have each test drawn out in clear-cut manner on a chart. When each curve is numbered for identification the chart can be torn off at the end of the day's work, with a complete record of all the tests made that day, the records to be used for file, or study, or future reference. The test work of the laboratory is thus always available and the curves can be photostated when it is desired to pass them out to interested

parties. The load values can be in no way affected by the human factor, which increases their value in case of dispute. When qualifying welders on an automatic recording machine, each welder can be handled a file of his test records.

d. Stress Ditribution Measurements.

This may sound difficult but it is easier than the tensile

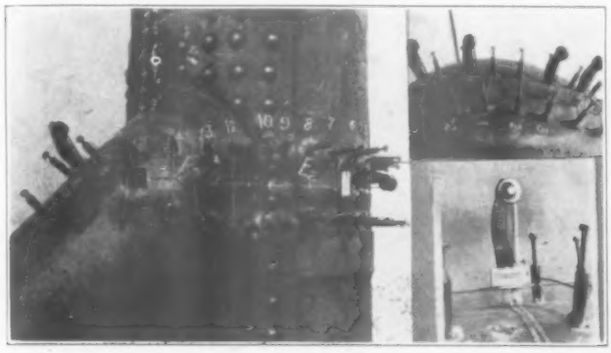


Fig. 4. Huggenberger Tensometers Fixed to Welded Structures.

test though more tedious by far. There are three ways in which stresses can be measured:

First, there is the hand strain gage shown in Fig. 3. The sharp pointed steel pins of this gage are a certain definite distance apart, known as the gage length. When these points move toward or away from each other the distance moved is registered on the dial indicator, reading direct in ten thousandths of an inch. Gage holes must be made in the members of the structure to be tested, using a very fine drill, two holes for each gage line. These gage holes in pairs are placed all about the structure at predetermined points so that a complete stress search can be made. The more thorough the stress search the greater number of gage lines. The man with the strain gage moves from gage line to gage line, taking readings on the unloaded structure, for instance. Then the structure is loaded and the

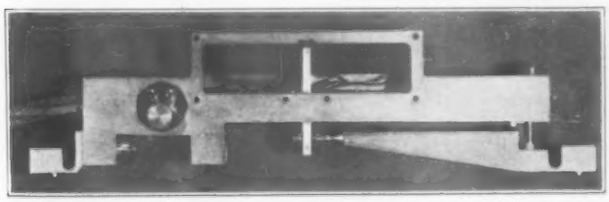


Fig. 5. Electric Telmeter Strain Gauge, 8 Inch Gauge Length.

strain gager goes around again. The differences in readings in each case are the tension or compression strains, tension or compression being readily determined from observing whether the strain gage points separated or contracted between the first and second readings. If dead load stresses are desired, it is necessary to take the first set of readings on the members before the structure is assembled, and the second set after assembly. The hand strain gage is the most usual method employed.

The second method of strain gaging is shown in Fig. 4. This method employs a little Swiss instrument known as a Huggenberger Tensometer, which is in reality a tiny lever system which multiplies movement between gage points by 1200 times. A pointer passes across a celluloid dial and the graduations are so made that strain readings down to 1/100,000ths of an inch can be made by simple visual observation. These instruments can be attached all over a structure either with small electro magnets or held in place by a thin steel needle clamped by two lugs spot welded to the metal surface or in devious other ways. Only a light pressure is required to cause the two knife edge gage points of the tensometer to get sufficient bearing so that 8 point leaded antique font 21 ems

they will move with the surface of the structure. This saves the time of a man passing from gage line to gage line, but it also costs money to use so many instruments, though the instruments themselves are comparatively inexpensive. As the structure or pipe line or pressure vessel or what not is loaded, all the little pointers move one way or the other across their scales and the amount of movement in each instrument can be quickly observed and the stress distribution plotted.

A third method, and by far the most labor-saving, is the use of the Electric Telemeter system. An electric telemeter (Fig. 5) is an electric strain gage, which contains two highly refined carbon piles. Movement between the gage points changes the resistances of these carbon piles unbalancing a Wheatstone bridge circuit, and the amount of unbalance is registered on a millivoltmeter. Readings of tension or compression strains to 1/100,000ths of an inch can be made, and the instruments in a normal temperature range are self-compensating for temperature. Telemeter gages may be

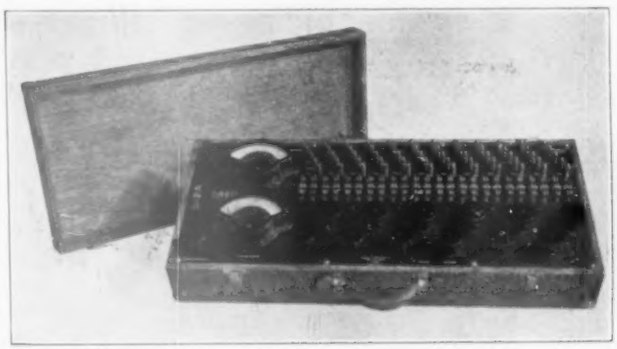
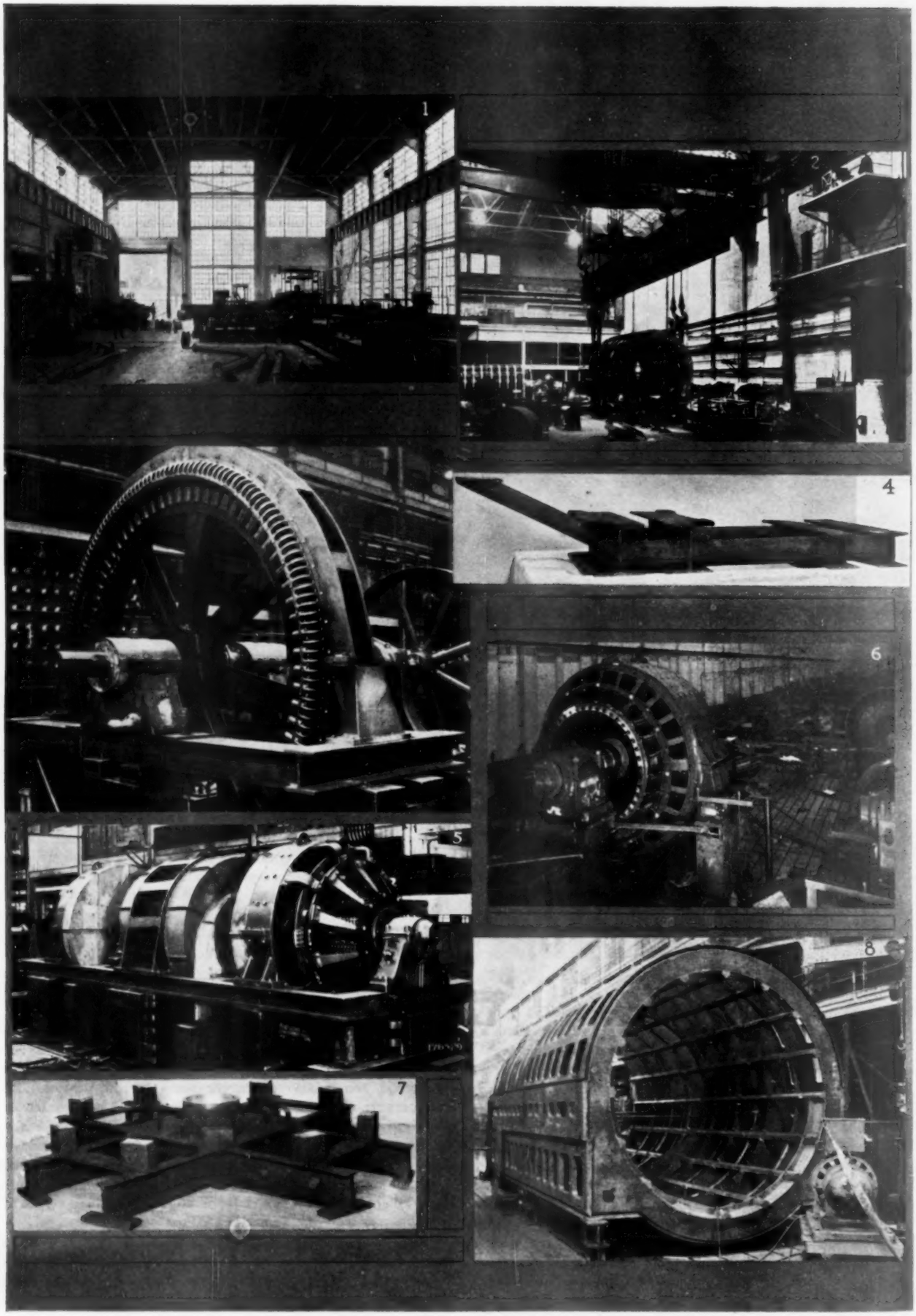


Fig. 6. A Twelve Element Panel Board Controlling and Reading 12 Strain Gauge Circuits.

fastened all over the structure like the Tensometers, preferably using small cap screws. All the circuits are brought together at a panel board (Fig. 6) where by closing switches one at a time, the strain readings at various points may be read at this one central control board. A storage battery supplies the current required. This is the quickest and easiest way to read strains and eliminate to the greatest extent the human element, since the man taking the readings is seated comfortably at a table instead of climbing all over a structure and getting himself in very awkward positions. But it is also the most expensive from the point of view of cost of equipment, unless arrangements are made to rent the equipment, which can in many cases be conveniently done.

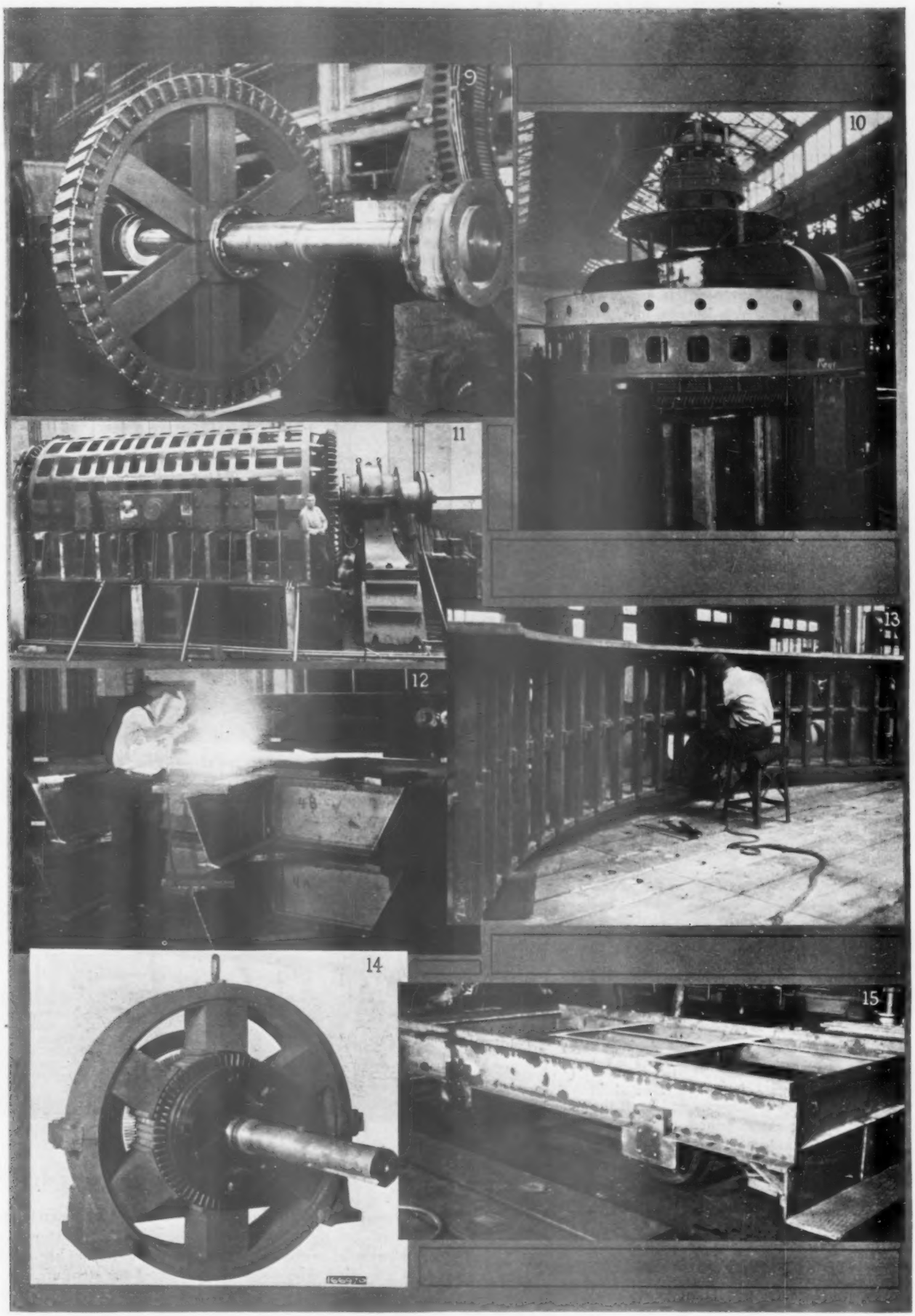
In all the preceding cases, having obtained the strain readings, they can be quickly converted into stress readings by multiplying by 30,000,000 which, as stated before, is a good round average figure for modulus. With stress distribution well plotted, the weak points of a structure quickly reveal themselves. By reinforcing here and there or changing cross sections or shapes, or fillets, structures can be made like the one-horse shay with all parts equally strong, but this is carrying the thing too far. At all events, stress distribution is good to know, and very frequently the engineer can do something about it.

This business of testing has not been lightly skimmed over to make it appear easy. If any engineer were allowed to play with any of the apparatus described above for the period of an hour, he could make a very creditable test. If any engineer still thinks the matter of testing is too deep and should be carefully side-stepped, then he would probably have made a better salesman or lawyer than engineer. It is realized that actual demonstration would aid in the understanding of the easy procedure of testing.



WELDED STEEL—STRONG, ECONOMICAL, UP TO DATE

1—The New Westinghouse Fabrication Shop is 170 Feet Long, 75 Feet Wide and 40 Feet High. A 15-Ton Overhead Crane Handles the Heavy Pieces. The Building Is Entirely Arc Welded. 2—The Welded Double-Tree Shown Here Allows Four 50-Ton Shop Cranes to Lift a 200-Ton Load. The Load Shown in the Picture Is an Arc Welded Turbo Generator Stator. 3—This Generator Has a Welded Frame Bearing Pedestals, Rotor and Bed Plate. 4—Bed Plate Fabricated from Steel Pipes and H-Beams. 5—A 2000 KW Synchronous Motor Generator, All of Welded Structural Steel Construction Except the Bearing Pedestals. 6—The Frame of This Motor Was Welded from Four Slabs, Each Weighing about Fifteen Tons, and Measuring 9 Inches Thick by 30 Inches Wide. 7—Vertical Shaft Bearing Made by Welding I-Beams, Rolled Steel Shapes and Plates. 8—A Stator 220 Inches Long Made Entirely of Steel Plate. 9—A Welded Rotor Built from Steel Plates and Rolled H-Sections. 10—All Parts of this 6,250 KV, 11,000 Volt,



225 RPM 60 Cycle Vertical Water Wheel Generator for the Coolidge Dam, Arizona, Are Made of Arc-Welded Structural Steel Members. 11—40,000 Pounds of Weight Were Saved by Making This 94,200 KV Turbo Generator Stator of Welded Steel. 12—Assembling Brackets for Bearing Supports of Vertical Water Wheel Generator by Arc Welding. 13—A Section of a Welded Stator Whose Outside Diameter is 33 Feet. 14—The Entire Frame and Rotor of This Motor Are Made of Structural Steel Members. 15—Welded Transfer Car Built from Rolled I-Beams and Steel Plates, Mostly of Odd Lengths and Sizes, Pieces Which Had Previously Been Classed as Scrap Material. Patterns, Castings and Machining Were Eliminated. A Good Example of the Use to Which Arc Welding Can Be Put in Building Shop Equipment.

—Photos by courtesy of the Westinghouse Electric and Manufacturing Co., East Pittsburgh, Pa., in whose shops the above equipment was fabricated.

A STRUCTURAL ENGINEER'S VIEWS ON WELDING

Automatic arc welding is destined to supersede manual welding for many, if not most, structural applications, writes Gilbert D. Fish, consulting structural engineer with the Westinghouse Electric & Manufacturing Co., in an article entitled "Electrical Industry Stimulates Welding Development", which appears in the Third Issue, 1929, of *The Pure Iron Era*, a publication of the American Rolling Mill Company.

Automatic arc welding has been used to some extent for shop assembling of built-up members, but not at all for field work, Mr. Fish states. Improved auto-arc machines and handling tools will shortly result in a greatly increased use of automatic welding at high speeds unapproachable by hand work, and the replacement of older methods for connecting steel will then proceed at an increased rate.

But Mr. Fish issues a timely note of warning against the "reaction from initial mistrust of a new method to the opposite extreme of unreserved acceptance without precaution"; and states that although the arc-welding process will spread, both in construction and in manufacturing, it may be retarded and temporarily lose favor if non-professional designers misapply it and if untrained operators execute it.

Welding eliminates the need for rivet holes; hence the welded member retains its original strength, which results in an important saving of weight in all types of welded trusses, in many plate girders, and in the heavier types of wind bracing for tall buildings.

The shop fabrication required for a structure may be simplified and reduced in amount by welding, states Mr. Fish. Punching can be eliminated from more than half the tonnage of an ordinary building, and numerous industrial buildings of one or two stories have been erected by welding without any preparatory shop work at all.

As regards cost, one linear foot of ⅜-in. fillet welding costs in the field only about half as much as six ⅞-in. rivets in single shear, and is as strong. In the shop the comparison is a little more favorable to riveting, but not nearly enough to upset the general proposition that welding is cheaper even if no advantage is taken of opportunities to save steel and simplify fabrication.

Welding has marked advantages for wind bracing, which was one of the chief reasons for adopting it for all the field connections of the Yale Library book tower, 135 ft. high, according to Mr. Fish. The earthquake bracing in the new 3,000-ton, 12-story office building of the Southern California Co., in Los Angeles, is an exaggerated form of wind bracing and has been laid out to develop high bending resistance in welded joints which, it is claimed, are much more compact and rigid than any riveted joints can be.

The economies of welding for the reinforcement of old bridges are so evident that its use by railroads for this purpose is spreading rapidly. More than once a bridge has thus been reclaimed, which would have been replaced by a new structure if the older reinforcing methods had been the only substitutes.

The safety of welded joints, as Mr. Fish points out, is dependent on technique, training of operators, inspection, and other factors that go to make up what is commonly known as procedure control. Contrary to beliefs still held by many, inspection by men qualified for such work is as reliable as any inspection possible on riveted joints.

ATOMIC HYDROGEN AT BUFFALO

The monthly meeting of the American Welding Society, Northern, New York Section, on Dec. 9, 1929, at rooms of Engineering Society of Buffalo at Hotel Statler, Buffalo, New York, was a joint meeting with the American Society of Civil Engineers, American Society of Heating & Ventilating Engineers, American Society of Mechanical Engineers, American Institute of Electrical Engineers and Society of Automotive Engineers.

The speaker was Mr. S. Martin, Jr., of the Welding Engineering Dept., General Electric Company, Schenectady. His subject was Atomic Hydrogen Arc Welding, he using a portable photophone giving a talking moving picture by Dr. Irvin Langmuir, Associate Director of Research of the General Electric Company. The wide interest in this very new process of electric welding was indicated by an audience of some 350 engineers, who appeared desirous of seeing and hearing the entire story from beginning to end.

The next meeting will be held at the same place on Jan. 13, 1930, under the auspices of The Linde Air Products Co.

ADDITION TO LINCOLN PLANT ENTIRELY ARC WELDED

The rapid momentum gained in the construction of steel framework for buildings by the welding process was given added impetus recently with the completion of a new building for the Lincoln Electric Co., Cleveland, Ohio. The new structure connects two existing buildings and provides an increase

Fabricating the Steel for the Lincoln Plant by Arc Welding.

in floor space of about 20,000 sq. ft. The new building is of the crane mill type, 200 ft. long and 100 ft. wide, and houses a 65-ft. overhead traveling crane, as well as enclosing a two-track railroad siding. This latter feature permits the

Typical Roof Truss Used in New Building.

unloading of materials and the loading of outgoing shipments within the plant.

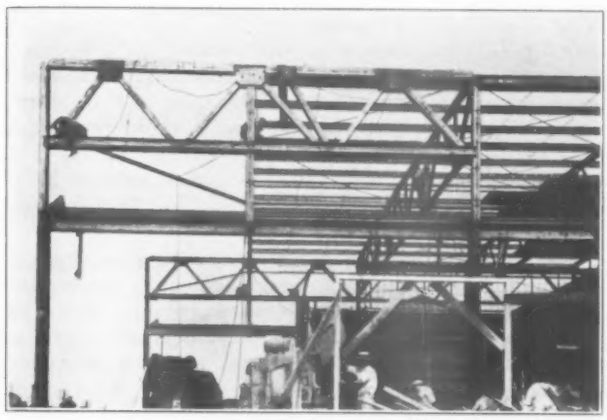
The steel used in this modern building was completely shop fabricated by the arc-welding process. Fig. 1 shows the construction of members in the structural shop of the Austin Co. of Cleveland, who designed and erected the structure.

To support the roof 10 trusses, 67 ft. long, placed on 20-ft. centers, were required. A typical truss as used in this building is shown in Fig. 2. The chords of these trusses were formed by T-sections, obtained by splitting 15-in., 38½-lb. I-beams along the center of the web. Each web number of the trusses is composed of two angles arc welded to the

chords on opposite sides of the web of the T, and tied together by straps arc welded to the flanges of the angles.

The crane runway and the 8-in. I-columns which carry the roof trusses are supported by 18-in. H-columns. The I-columns are spliced to the H-columns directly above the crane runway. These splices were made by arc welding ½-in. steel plates along the flanges and webs of the columns. The crane runway is formed by 20-in. I-beams on top of which are placed the runway rails.

Over the railroad tracks heavy trusses are required to distribute the load from the roof trusses to the columns,



Carrying Trusses in Place on East End of Building.

and also to carry the crane runway. These trusses are composed of 8-in. I-beams and heavy channels. Fig. 3 shows these trusses in place.

The simplicity of arc-welded design allowed many improvements, and a great reduction in weight by the elimination of many gusset plates and connecting angles required in riveted construction. This factor, coupled with the use of bolts to hold the various members in place during field erection, reduced the cost of erection to equal that of riveted construction.

FIFTH ANNUAL CONFERENCE ON WELDING HELD AT PURDUE UNIVERSITY

The welding conferences held annually at Purdue University, Lafayette, Ind., have grown in import and scope year after year. The first conference of this type occupied but one day; this year three days were required for the program. This year's welding conference, which was the fifth to be held at Purdue, covered the period of December 11th to 13th, and was held in the Michael Golden Shops under the direction of the Engineering Extension Department and the Department of Practical Mechanics of Purdue University with manufacturers of welding equipment cooperating. Special demonstrations and exhibits were arranged to follow each session, both morning and afternoon. This year's program showed a decided trend toward discussions portraying the development of processes. A symposium on new processes and devices was held on the afternoon of December 13th, discussions centering around tube turns, cutting with propane gas, and an electric torch for welding Tobin bronze.

The papers scheduled, with their authors, were as follows: "Notes on Welding as Applied to Structural-Steel Construction," by E. W. P. Smith, of the Welding Equipment & Construction Co., and the Lincoln Electric Co.; "Ox-Welded Pipe Lines for Oil and Gas," by R. W. Boggs, Linde Air Products Co.; "The Atomic-Hydrogen Arc and Its Applications," by F. Martin, Jr., General Electric Co.; "Training Welders," by Lt. W. M. Lanagan, Air Corps Technical School, Rantoul, Ill.; "Arc Welding Thin-Sheet Metal by the Carb-O-Flux Method," by R. W. Holt, Fusion Welding Corp.; "Multiple Plate Cutting," by R. F. Helmkamp, Air Reduction Sales Co.; "Hard-Facing Metals in the Limestone Industry," by E. H. Baker, Indiana Limestone Co.; "Methods of Building Machine Tools, Jigs, and Fixtures by Welding," by J. R. Weaver, Westinghouse Electric & Manufacturing Co.; "Welding Copper," by W. C. Swift, American Brass Co.; "Problems of the Small Structural Shops," by I. B. Yates, Joseph T. Ryerson & Son; "Inspecting Welding," by J. B. Hendrickson, of Mellon, Taylor, Hendrickson, Inc.; and "Examining Welds With the X-Ray," by H. L. Maxwell, Associate Professor of Chemical Engineering, Purdue University.

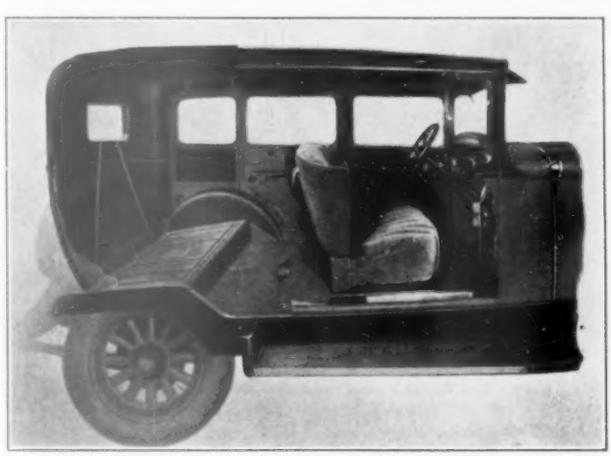
The evening of December 12th was given over to an informal dinner in the Home Economics Building, at which Dr. R. B. Wetherill, of Lafayette, Ind., gave an illustrated travelogue and lecture. Special demonstrations were given on the afternoon of the last day related to cutting of cast iron, bronze welding, Stelliting, the oxygen lance, electric welding, thermit pipe welding, aluminum welding, and cast-iron welding.

DODGE BROS. POINT WITH PRIDE TO THEIR WELDED CAR BODIES

The Dodge Six bodies have been entirely redesigned to take advantage of the advances made in stamping and welding practice. The new bodies, known as the Dodge Mono-Piece type, are of one-piece construction and are said to have almost unbelievable strength and rigidity. This means much to the driver or rider, who considers the car body as his protector not only against the elements of weather but also against injuries resulting from accidents. Moreover, such construction delays the appearance of "oldness" that every car body takes on in time, and makes for driving without body squeeks.

Here is what the Dodge Brothers Corp. have to say about the new welded bodies:

"Certain it is that in the new Dodge Mono-Piece body it is impossible to find a line of weakness. It stands to reason that in riveting there is always a loss of strength because of the



Cut-Away View Showing Interior of Dodge Mono-Piece Body.

metal that has to be cut away to form the hole for the rivet. No matter how well the rivet fits the hole, it cannot replace the metal that has been removed. With welding there is no removal of metal, there are no joints or seams, complete unity of the entire construction is secured.

"What this means to the car owner is greater safety, longer life of the car, and added quietness. Noise in a car is produced by relative movement of one part to another. When the body is all of one-piece construction, as it is in the Dodge Mono-Piece design, there can be no relative motion. Consequently the body is silent.

"It is this same relative motion—the result of stresses and strains—that causes a body to be known as "old". And "old"

bodies are one of the main reasons why cars are traded in for new ones. In the Dodge Mono-Piece body there is no relative motion, so the car remains young longer.

"As far as safety is concerned, who wouldn't rather ride in an all-steel Pullman than in one of the old-fashioned, composite railway coaches? The Mono-Piece steel body is just as far ahead of the composite type of riveted body as the Pullman car is ahead of the composite coach, in the opinion of Dodge Brothers' engineers. Today, with existing high speeds and crowded roads, the factor of safety is extremely desirable."

MILWAUKEE BUILDING CODE BEING REVISED

The Milwaukee, Wis., Building Code Committee, of which William F. Eichfeld is chairman, is formulating a new code for that city, in the belief that the building industry must prepare itself for a new era brought about by the growing adoption of fusion welding in the place of riveting and other recent advances in structural design, according to the *Milwaukee Journal* of November 30th. Mr. Eichfield is quoted as being of the opinion that in a few years hence there will be no more noise in the erection of the steel skeletons of large buildings, for fusion welding seems sure to take the place of the clamorous pneumatic hammers of the riveters. There is a tremendous saving in material by welding, making possible lighter foundations and footings, he said, and the process should save $60 to $100 a ton over present methods. Mr. Eichfield is vice-president and general manager of the A. F. Wagner Architectural Iron Works, who provided the structural steel for the Milwaukee City Hall, the public library, several of Milwaukee's school buildings, the cells for the federal penitentiary at Atlanta, Ga., and a number of other important structures.

100-TON SHIP ALL WELDED

An interesting job of arc welding was recently completed at the Houston Ship Channel by the well known firm of Barnes Machine Shop, Houston, Texas. A boat of 100 tons

Large Arc Welded Boat and the Welding Machines Used.

capacity was entirely electrically welded. The size of the boat was 140 ft. long, 20 ft. wide, total welding was over 2,000 feet on one-quarter inch plates.

There were many different problems to be contended with on this job, among them being the fact that 60 per cent of the welding operations were performed overhead. From a layman's observation it appeared that the overhead arc welding hour after hour was rather enjoyed by Mr. Barnes expert operators, but among the welding fraternity it is appreciated that continuous overhead welding with one hundred per cent results is very difficult to accomplish. Lincoln Stable Arc Welding Machines and Lincoln Blue Stable Arc electrodes were employed exclusively throughout the welding of this boat.

Design for the electric welded construction of this boat was developed by Mr. J. Barnes, of the Barnes Machine Works. When the boat was tested by Marine Inspectors it was passed as a good job and no leaks were found. The owners of the boat have stated that the job of arc welding as performed by Barnes Machine Shop was an unusual and strikingly economical application as compared with the ancient riveting and caulking and are very much pleased with it, not only with the quality and cost of the job, but also with future savings in maintenance costs. Riveting is apt to cause leaks through the rivet holes, demanding expert caulking. Such leaks also cause fast corrosion with results of corrosion cracks from rivet holes to cauking edge. Electric welding, however, makes the joints and plates a homogeneous mass of steel, with no possibilities of leaks for the entire period of the boat's existence.

Mr. Barnes has always stepped forward in the progress of electric welding applications. About two years ago he cut up to proper sizes huge cast iron pipes for the City of Houston Water Department when every other method had failed or was too costly. He employed the electric carbon arc process, using 300 ampere Lincoln welders to cut the 36 inch pipes 1 inch thick, as per City Engineer specifications.

At present Mr. Barnes has two stationary machines for ship use and two gasoline driven mounted on trucks, ready for any emergency for portable work on jobs where electric power is not available. The photograph shows one of his field trucks with two welders mounted on same in actual operation on the boat job.

WELDING SAVED THE TURKEY

When Mr. L. R. McLean of the Harris Sales Company, Philadelphia, Pa., entertained Mr. and Mrs. Lorn Campbell, Jr., Cleveland, Ohio, for Thanksgiving dinner, disaster was averted by the presence of a welding torch. It appears that during the excitement connected with preparing the turkey for the oven, the oven door received a jolt and a bracket bolt which had been gradually loosening up gave way and the door banged open, breaking the hinge lugs. Ordinarily a hostess would have been discouraged by this kind of calamity, but this one just happened to know that there was a complete oxy-acetylene welding unit in the garage. Mr. McLean was summoned away from a pleasant conversation with his guests and when he was informed of the situation, galloped to the garage to get the torch into action. By the time the gobbler was properly stuffed and ready for heat treatment, the welding job was finished and the oven door was swinging in its usual place. This is the first case on record where welding has proved to be of such extreme importance to a hostess.

EXTENSIVE CUTTING JOB IN PENNSYLVANIA STATION

The Pennsylvania Railroad station at Camden, N. J., is of the old terminal type with columns in the center. The station is large enough to accommodate 12 tracks and long enough to shelter 10 cars and 1 locomotive on each of these tracks. The station is now in the process of reconstruction and a contract has been let for entirely dismantling the old structure. This is being done by taking down one half of the station at a time, that is, closing six tracks at a time.

It is reported that the contract called for complete dismantling of the old station in sixty days. Enough cutting was involved to require the continuous use of ten complete cutting outfits, several makes, including D-B, K-G and Milburn being used. Each outfit works eight hours a day on the job. As the material is lowered, it is cutting up to charging box sizes and loaded on the cars to be sent to the mills. Six outfits were used for the main job of dismantling the structure and the other four for cutting up the pieces into charging box sizes.

Hints for the Welder

WHEN YOU FIND a new way to do a hard job, or finish a particularly interesting weld, can you describe how the work was done? . . . . . Have you learned some little stunt every welder ought to know? . . . . . Write to us about these things . . . . . This department helps you welders to help each other. Write up your ideas any old way and just make rough pencil sketches . . . . We'll fix them up for publication.

REMOVING ALUMINUM FROM ROTARY FILES

By Geo. T. Kerr

McIntyre & Kerr, Berkeley, Calif.

Before welding a broken aluminum casting the pieces are usually V'd with the aid of flexible-shaft equipment and rotary files, and after welding the excess weld metal is removed by the same means. After continued use the rotary files become clogged with particles of aluminum and do not cut as rapidly as when clean. A simple and effective method of cleaning them is by the use of a 30% solution of sodium hydrate, made by dissolving 40 grams of caustic soda in 160 cubic centimeters of water. This will dissolve the aluminum clogged in the files without injury to the steel.

KINKS FROM AN AUTO WELD SHOP

By Jos. C. Coyle

There are tricks in all trades and here are a few of those picked up by the Broadway Metal Weld Shop, Denver, Colo. This shop caters largely to automobile repairs, but no job is too large or too small. A specialty is made of aluminum welding—mending everything made of aluminum from a per-

Molten Aluminum Scrap Being Poured Into the Mold.

colator up—and therein lies a story which may interest other welders. This shop makes its own aluminum welding rod, using scrapped crank cases and other aluminum parts which cost little. These are broken up every now and then, melted, and cast into rods. About 80 to 100 pounds of these are molded at each run.

The scrap is placed in a pot, holding about a gallon, which is suspended in a temporary furnace of firebrick, with a small space about the pot for flames to ascend. The mass is melted down with an acetylene torch, after which it is kept sufficiently hot with a gas burner, the flame of which is directed upon the bottom of the pot through an opening in the front of the furnace. After melting down, a handful of an aluminum flux is added to the metal, stirred in thoroughly, and the dross then skimmed off. The process is repeated, using this time about two table-spoonfuls of the flux. This is very important, as it makes the rod flow easily beneath the flame, and insures a smooth, perfect job. The flux costs

Welding Cracked Engine Blocks Is Made Easier by Tipping the Car.

nothing, as it is material that has become wet and hence unfit for welding operations, and would ordinarily be thrown away.

The molten metal is dipped up with a long-handled ladle and poured in a mold made of a 3-ft. section of angle iron, as shown in the illustration. This mold is closed at the back end, with a large loop welded on for a hand hold. It is held at a slope away from the operator and metal poured in until it runs down near the opposite end. It is then quickly tilted slightly toward the workman, with a slight jerk sidewise, filling out slack places in the rod as the aluminum runs back. Different sized angles are used for larger and smaller rods, and with a little practice very good ones may be turned out, though they are larger than the commercial rods, and not absolutely round. However, they are easily used on light work, and are found to be ideal for heavy welding. The mold must be heated over the fire before starting to pour; the rods are then easily jarred loose from the mold. This furnace is also used for preheating metal parts before welding.

The gas burner shown here, using natural gas, was made from a 6-in. section of 2-in. pipe, into which the gas is fed by

¾-in. pipe, welded to it by three small cross braces. The gas pipe ends in a small orifice of such size as to suit the kind of gas used. For manufactured gas, about ⅛ in. is ideal; natural gas required a smaller hole. The burner gets its own air through the rear of the 2-in. pipe. A Ford brake housing is used as a base, with a window ratchet welded on the top. In turn, a 3-ft. section of ½-in. pipe is welded to the ratchet. Over this slips a 6-in section of 1-in. pipe, which is welded to the gas outlet at right angles, and is held at any desired height on the rod by a set screw. The ratchet allows the burner to be tipped forward or back as desired.

Pure ground asbestos is mixed with water and used to plaster the cracks in the furnace. This mixture is also found ideal for holding small, light articles, such as two rods, end to end while welding them. Each part is imbedded in a ball of asbestos and the ends placed as desired, the asbestos holding them in place.

In welding holes in thin aluminum it is often difficult to back up the weld in a way to secure a smooth job, particularly if the hole or place to be mended is in an inaccessible place. In such a case it is often possible to back up with a sheet of galvanized iron, bracing it firmly in some way and then building up the spot right upon the iron. When the weld has cooled the iron is pulled away, leaving only the thin galvanized surface adhering to the aluminum of the patch.

In welding engine blocks on automobiles, there is always an accumulation of water to be reckoned with, which cannot all be drained out. An elevated cradle-shaped device on trunnions, constructed largely of angle iron, welded, is used by this shop in order to get at such a job, as well as in working on the chassis. The car is driven on the device, chained down, and tipped over sidewise until the cracked side of the engine comes up, the water draining away from the crack.

THE WELDER'S SHOP SIGN

By Willis Parker

It goes without saying that the welder should have a sign of some sort over the door of his establishment, or upon the building, to identify his place from the neighboring business houses so the customer can find him. But there is another important use connected with the sign, and that is the selling of the service, the name, and the address to persons not seeking the firm because of not having immediate need of the service. In my opinion the latter function of the sign is far more important than the first. And, considering the welder's sign from the second angle, it is positively true that the sign may be an asset or a liability.

Obviously a poorly constructed, dingy, inartistic sign will give the public the impression that the welder is careless, inefficient, and cheap. In spite of appearances, however, the welder may be such an efficient workman that he hasn't had an opportunity to give any attention to the condition of the sign over his door and replace it with something better and cleaner. But a prospective customer may go elsewhere rather than patronizing a shop carrying that kind of sign over its door.

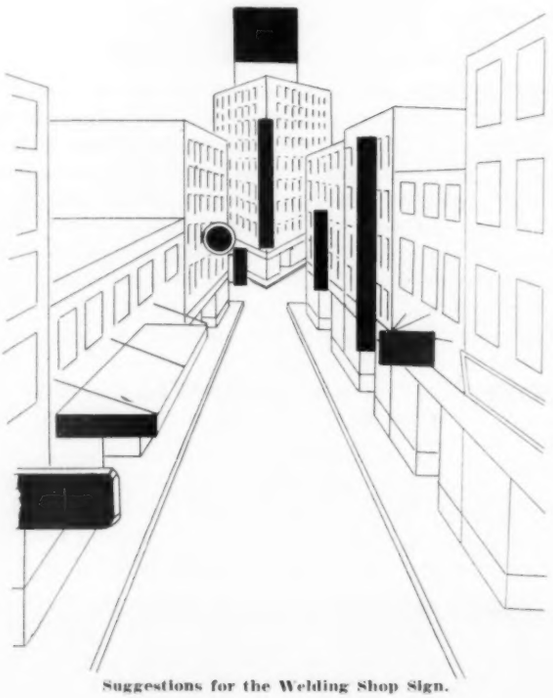
The National Welding Co., Denver, Colo., has a sign that not only thoroughly establishes the identity of the firm and its location but brings in much additional business because it so impresses upon the minds of those who see it the name and the business that when they are in need of welding service, whether or not they ever had such service before, they know exactly where a welding company is located.

Although location has much to do with the effectiveness of the sign, not many welders are located away from heavily traveled streets and roads. Even those in hamlets are generally located on the state highway that passes through the community, and, therefore, are in position to demand some attention of passing motorists—if the sign contains adequate attention-impelling elements.

The National Welding Co. is located on 14th St., near the foot of the 14th St. viaduct. This is one of the main arteries of travel in the city; many thousands of automobiles and trucks pass the place daily.

Extending outward from the face of the building and over the sidewalk is a neon electric sign bearing on each side, so it can be read from either direction, the simple message—"NATIONAL WELDING". The sign is not more than 4 ft. long nor more than 3 ft. high, and is about 15 ft. above the sidewalk level; but owing to the fact that the building is at the foot of the viaduct, the sign is about on a level with the elevated portion of the roadway.

As a motorist, crossing the viaduct, starts down the sloping approach to reach the ground level of the street, his eye



Suggestions for the Welding Shop Sign.

catches that blazing word "WELDING". It makes an indelible impression for two reasons: First, the vivid, penetrating light emitted by a neon sign demands attention, especially when such a sign has no competition from neon signs in the immediate neighborhood; and second, on account of the sign "batting" him in the eyes just at the time he is preparing to apply brakes, shift gears, and otherwise prepare to descend the hill and enter the maelstrom of traffic at the foot. When the mental picture of "WELDING" comes to his mind, the motorist immediately associates it with the 14th St. viaduct. We may assume, then that when he has something to weld, although he knows no welder from previous dealings, he will run down to this company first.

Because of its illumination, it is admitted that the sign is more effective at night than in the day time. From the standpoint of advertising only—that is, making an impression upon the mind of the future patron—the night-time advertisement is preferable to the day-time publicity for the reason that the motorist may be recreation bound and not occupied by business problems that might cause him to pay no heed to the sign. With his mind free from business problems, he is more than ever open to suggestion and impressions.

A recent survey undertaken by the writer to determine whether or not the public was influenced by electric signs, may prove helpful to welders. Questioning many persons

relative to the effect and influence of signs upon them, adduced a variance of opinions as numerous as there are human personalities, but in every instance I ascertained that the public accepts signs in much the same manner that it accepts the furniture and fixtures, equipment, and appearance of workers—as a part of the business.

A well-appointed sign—electric or not—indicates to the public that the business is prosperous, that it is equipped to accomplish expert and satisfactory work, employs skilled workers, and is in various other ways undoubtedly reliable.

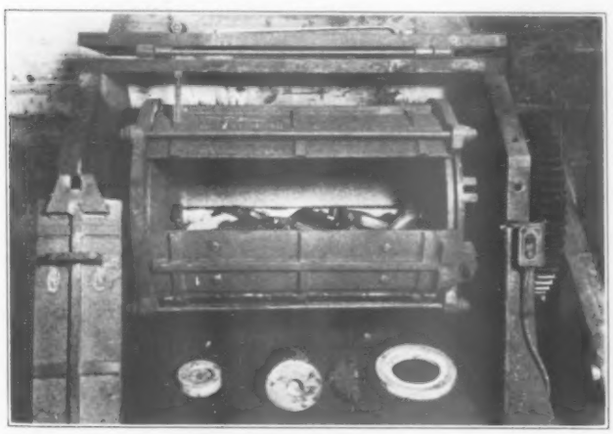
Welders, furniture dealers, sheet-metal workers, department stores—in fact, all kinds of businesses—have given great consideration to the size and type of electric signs to use. Should they be large, or small, should they be vertical, horizontal, or flush with the front of the building? These are questions that the welder should ask himself when placing a sign. Generally speaking, if the welder is seeking business from every part of the city, he should have a large sign that can be seen at a considerable distance; if he is off the main-traveled highway, a large sign placed on top of his building and facing the heavily traveled streets will accustom the public to his location. If the sign is merely for the purpose of establishing the firm's identity and street address, a small sign is sufficient.

For the assistance of welding shops, a sketch is presented, illustrating the various methods of placing electric signs.

ARC WELDED TUMBLING BARREL

By George T. Kerr, McIntyre & Kerr, Berkeley, Calif.

The tumbling barrel shown in the photograph is roughly two feet in diameter by four feet long. Originally, this barrel was made entirely of cast-iron. The slats as cast were about 3/4-inch thick and ribbed. I cannot say how long they lasted, but I do know we were constantly buying new slats, they would wear thin in the middle and then break, and the



After Two Years' Service the Welded Slats of This Tumbling Barrel Show Very Little Wear.

pieces rattled, were never very heavy; probably never over five pounds each.

Due to the constant annoyance of breakdowns and replacement of slats we decided to construct an arc welded barrel. The first stage was to roll a 5/8-inch steel plate to the correct diameter, weld the reinforcing strips in place the long ribbed 1-inch square steel and the short pieces about ½-inch x 1-inch, the slats were then cut with the burning torch, end pieces were welded to the removable sections and handles welded on. Our first handles were made of round steel but the constant vibration cause them to break above the weld in about two to three months.

We finally welded 1/4-inch x 1-inch material shown on the slat standing at the left and have not had to replace handles since. The welded slats were not normalized as is our usual practice. The steel peens with the action of the tumbling instead of wearing away as cast-iron does, and although the barrel has been in service about two years the slats show no wear to speak of. The pieces under the barrel are not by any means the largest handled; they weigh, from left to right: 2¼, six, eight, pounds, respectively, and were formerly sand blasted. Pieces weighing 51 pounds each, a charge of four filling the barrel, are regularly rattled. The entire job, including material, cost in the neighborhood of $40.00 to $45.00, and we have saved at least that amount in maintenance charges and probably more and the machine is constantly in service.

If arc welding will stand the constant hammer and vibration that it does in this machine it does seem that manufacturers would do well to devote more study to its possibilities.

SIMPLE WELDING JIGS AID PRODUCTION

By F. J. Fitzgerald

Use of the proper jig in welding has a very important bearing upon the production rate in any factory. Automobile manufacturers have long realized this, and no little credit for the amazing yearly totals of the leading motor-car producers can be directly credited

Using Jig Made of Angle Iron for Welding Steel Band.

to a universal use of all sorts of jigs through the entire poduction line.

Sheet-metal shops employing welding for the fabrication of their products are also large users of carefully designed jigs. Many sheet-metal plants have increased their rate of production several hundred per cent in this way.

The adoption of a simple jig by a concern engaged in turning out flask bands for foundry use, did away with the necessity of installing expensive special equipment. The illustration shows a welder using this jig while joining the flask band. These bands, nothing more than a strip of sheet steel bent in the form of a rectangle, are used in the foundry to bind together the wooden flash or box which holds the sand mold for a casting. To complete the rectangle it is necessary only to close one corner by welding.

Referring to the illustration, it will be seen that the band is held

between two pieces of metal. These are simply short pieces of angle iron nested one into the other, turned upside down, and clamped to the table. The heel of the upper angle has been coped out so that an oval hole is left. A simple treadle arrangement consisting of a piece of steel wire and a bar completes the fixture. The corner of the band to be welded is slipped beween the two angles until it is opposite the hole. Then pressure on the treadle clamps it in place during welding.

The effectiveness of this jig should encourage welders to think out similar ones for their own work. Very often such a handy welding aid will materially speed up production and greatly facilitate the job at hand.

AUTOMATIC WELDING OF END-PLAY LINERS ON LOCOMOTIVE JOURNAL BOXES

In the September, 1929 issue of the *Baltimore and Ohio Magazine*, an interesting story is told by C. C. Hare on how welding has overcome troubles caused by the loosening of the end-play liners on locomotive driving boxes. These liners habitually became loose from the fact that when hot brass was poured into the cold cast-steel box, the brass contracted upon cooling and pulled away from the box. Between the periods that a locomotive is returned to a back shop for classified repairs, these end-play liners must be renewed a number of times, each renewal entailing several hours' labor, not to mention the time the locomotive is out of service, due very often solely to this one condition, says Mr. Hare, who is foreman welder of the Mt. Clare shops of the Baltimore and Ohio Railroad at Baltimore, Md.

Although it has been customary to groove, dovetail, and drill the driving boxes for pin inserts, as shown in Fig. 1, before pouring the brass, yet this method has met with very little success, as Fig. 2 indicates. It will be noted that the liner in Fig. 2 is broken about in half, with fragments gone, and the remaining section is cracked.

To eliminate this troublesome condition, the idea was conceived of welding this brass to the box and building the whole liner up in this way instead of pouring it. Fig. 3 shows a box prepared for the new operation, requiring only a rough cut to be taken as compared with the many operations necessary in the preparation of the box shown in Fig. 1.

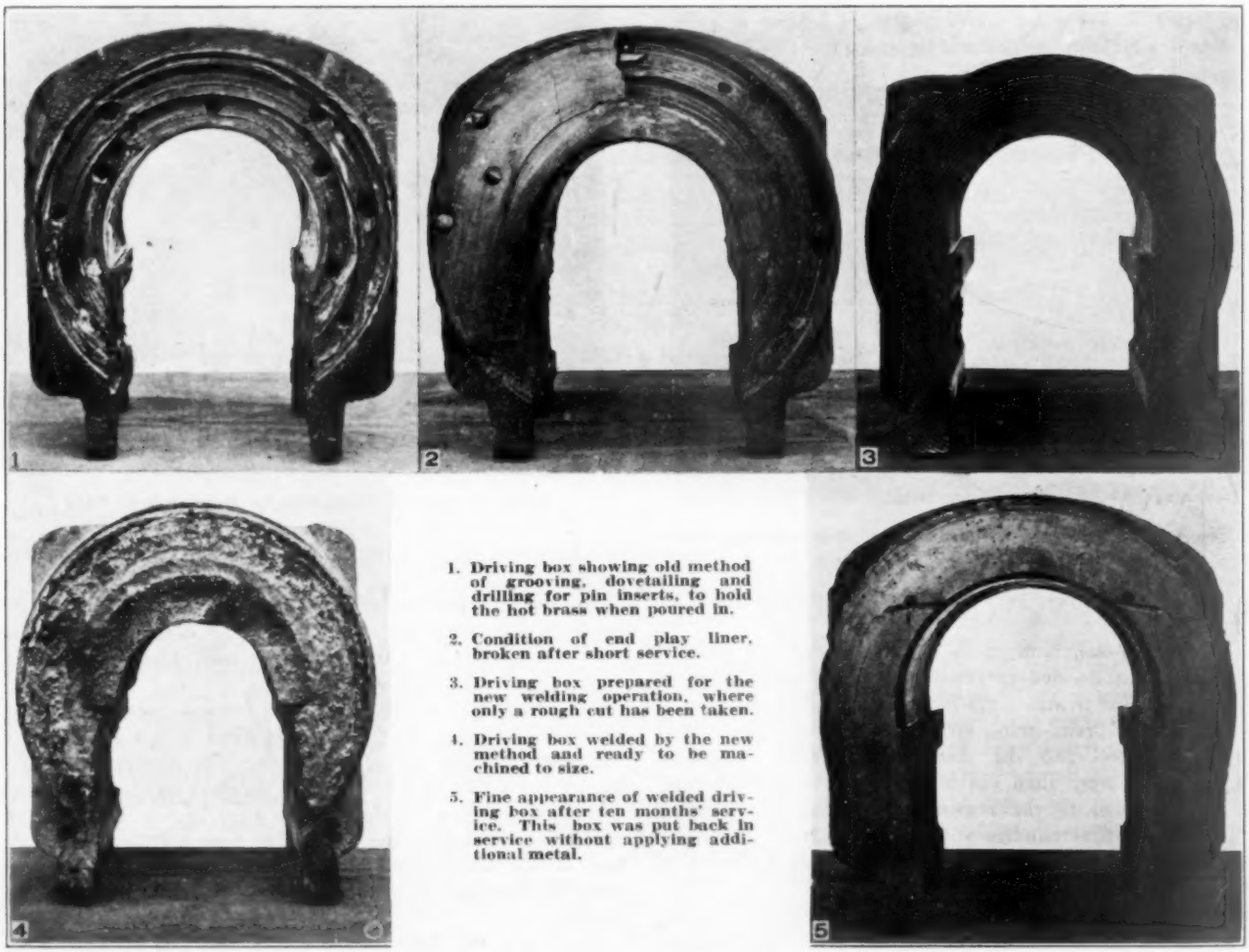
At first the welding by the new method was carried on by hand, using 3/8 in. cast phosphor-bronze rod; and it was found that good penetration could be gotten, making the liner an integral part of the box. This process was found to be uniformly satisfactory, but it required technique and was very fatiguing to the welder working in 8-hr. periods. Hence consideration was given an automatic head for this work, although, says Mr. Hare, a head had never been used on this size electrode or with 600 amp., which was the strength of current required.

A trial installation of three months was so satisfactory that a permanent installation of three automatic heads, each operated by its own 750-amp constant-potential welding set, was made. The turntables, arms, mounting support, automatic heads, and reels for holding the wire, all were designed and made at the Mt. Clare shops. The automatic head for the trial installation was built by the General Electric Co.

With the automatic heads, it is possible to weld four to five of the old-type boxes or eight of the new-type boxes per day, while by hand welding half this number was a reasonable day's work.

One of the chief advantages of the welded box, Mr. Hare points out, is the ease of refacing after becoming worn, as it is necessary only to sand-blast the box, weld one or two layers of metal, and machine to the proper dimensions. The welded box in Fig. 5 showed a wear of only 1/32 in. after ten months' service; it was placed immediately back into service without the need of applying additional metal.

The cost of operation by the old method, including facing,



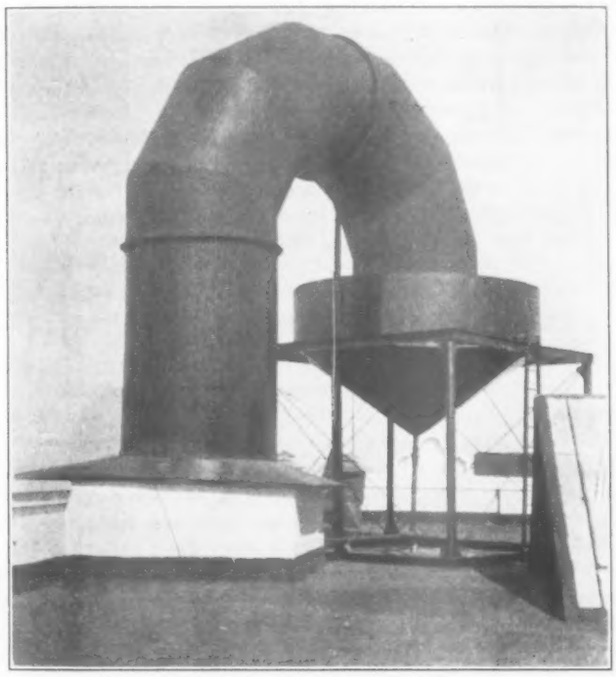
1. Driving box showing old method of grooving, dovetailing and drilling for pin inserts, to hold the hot brass when poured in.
2. Condition of end play liner, broken after short service.
3. Driving box prepared for the new welding operation, where only a rough cut has been taken.
4. Driving box welded by the new method and ready to be machined to size.
5. Fine appearance of welded driving box after ten months' service. This box was put back in service without applying additional metal.

grooving, dove-tailing, drilling, pouring metal, and machining to the proper size, including cost of the metal used, was $15.24 per box, whereas all the labor operations and current and welding material used by the new method cost only $13.56, representing a saving of $1.68. If consideration were given to this operation as a time and labor saving device, Mr. Hare concludes, the saving would amount to many times the $1.68 shown in the initial cost. Application has been made for patents covering this method of welding end play liners.

WELDING JOB CURBS SMOKE

By Jos. C. Coyle

The big steel smoke stack on top of the new mail-order plant and retail branch of Montgomery Ward & Co. in Denver was curved at the top by cutting and welding until it drops within the top of a cone-shaped draft regulator, as



Smoke Stack Bent by Cutting and Welding.

shown in the illustration. By forcing water into the regulator by means of a pipe leading into the bottom of it, which is also shown, the smoke particles are separated out and the draft is controlled. No one realizes the trouble caused by smoke in a city more than does a large merchandising establishment like Montgomery Ward. Hence careful attention was given to the heating installation in order to make his new, large building cozy in the coldest of weather, with the minimum of smoke. With 16 acres of space in the 8-story structure, the heating problem was no small one.

REPAIR OF CAST IRON KNIFE GUARD

A correspondent in Portland, Ore., describes the oxy-acetylene welding of a cast-iron knife guard which was broken when the knives struck a knot in the forward end of a board, snapping the other end against the guard. The edges of the break were first beveled from the outside to form a 90-degree vee. The broken end was then fitted in place and secured with C-clamps. Only local pre-heating was necessary since the metal was free to expand. The oxy-acetylene flame was directed at the bottom of the vee at one end, and the weld was begun by bringing a section about two inches long to the molten state. Cast iron welding rod and Ferro flux were used. The operator was careful to see that the sides of the vee were thoroughly melted and fused with the added metal. Whenever gas bubbles or white spots were noticed, flux was added to remove these impurities. The section was built up slightly higher than the rest of the surface. When one section was finished, the base metal in another two-inch section adjoining it was melted and the same operation repeated, care being taken to secure complete fusion with the sides and the end of adjacent welded section. The entire break was completely welded in this manner. After welding, the piece was covered with asbestos paper and allowed to cool slowly, thus relieving any internal strains and insuring a true gray iron structure in the finished weld. In a very short time it was back at its old place on the planer protecting the workmen.

A COLD WEATHER SUGGESTION FOR THE WELDER

When making reference to an issue of Oxy-Acetylene Tips, the monthly publication of the Linde Air Products Co., our attention was caught by an article describing the method of making a salamander. It is not very far now from the season of real cold days and during the real winter season many occasions are found for using a fire out-of-doors. Such a fire often has to be used to prevent destruction of concrete and cement and stone work which has just been set and laid in place, and to hasten the curing of it. At other times a fire is needed to keep materials from being spoiled by cold, or to provide comfort for workmen who have to work out-of-doors. A salamander really has a great many uses and it is one of the easiest things for a welder to make. Sometimes a suitable tank or container can be found and it is only necessary to weld on three legs and cut holes for draft near the bottom; however, a good sturdy salamander can be made by rolling a shell of ⅛-inch steel plate, making a cylinder about 3 inches in diameter and 4 ft. or 5 ft. long. A circular plate is cut out for the bottom and pieces of angle iron welded on for legs. Holes for the draft are easily cut with a cutting torch and it is recommended that after all welds have cooled the legs should be heated and bent outward so as to make it more difficult to turn over the salamander. This device will burn scrap wood and serve a variety of useful purposes during the winter. The welder should exercise sufficient care to make a good strong job because even though one of these devices may be wanted for only a short time at first, the chances are that it will actually be used more than was expected and it isn't any more difficult to weld it strongly enough so that it is sure to last through the season.

STEEL CASTING WELDED TO ROLLED STEEL TUBING SATISFACTORILY

The Electric Steel Founders' Research Group recently published in their Research Group News an answer to the question of whether steel castings can be satisfactorily welded to rolled or forged steel. Quoting this pamphlet directly, they say, "There need be no hesitation in utilizing a combination of cast steel and rolled or forged steel, when the performance of the composite piece is to be of such nature as to make this fabrication advisable from the standpoint of endurance under service conditions, and when the utilization of such composite manufacture is desirable from the standpoint of economical construction, in the long run."

As an example, the pamphlet shows a photo of a cross section of a locomotive return bend employing a steel casting welded to rolled tubing. This was done by a railroad company according to a routine method which has been employed over a considerable period of time. It was stated that this method of fabrication was entirely satisfactory. The assemblage presented an effective means for demonstrating the fact that welding is sometimes used in conjunction with steel castings for a metal part, when performance under service conditions may not be injuriously affected by the fabricating method employed.

BOOK ON PIPE DESIGN

"Fabrication of Welded Piping Designs" is the title of a new book just issued by The Linde Air Products Co., New York City. It is intended for the use of the executive, welder foreman and welder, to enable them to apply successfully the fundamental designs used in welding pipe installations. The book is divided into three parts. The first part contains a procedure control for oxy-acetylene welding line joints in steel or wrought iron pipe, a procedure control for the fabrication of fittings and practical hints on radial cutting, fabrication of headers, and cutting pipe to weld pipe connections at various angles. The second part gives complete instructions for making templates for pipe fittings, and the third part is a collection of tables for estimating costs of welding in the shop and in the field. The wealth of useful data and illustrations contained in this book recommend it strongly to all those who are interested or engaged in the welding of pipe.

ANNUAL MEETING OF C. G. M. A.

Date for the Annual Meeting of the Compressed Gas Manufacturers' Association has been established as Tuesday, January 28th, 1930. At this time we are unable to give full details, as the duration of the meeting will depend upon the program committee which is earnestly preparing the schedule, and upon the Dinner Committee which is working on the preparation of a bigger and better dinner and entertainment feature.

TRANSLATING POSTERS ON SAFETY

Many shops who are faced with the problem of getting the safety idea across to groups of foreign laborers who cannot read English could well follow the example of the Wilson Foundry & Machine Co., of Pontiac, Mich., who had a number of safety posters translated into Spanish and then blueprints made of these for the benefit of Mexican workers. The man who speaks a foreign tongue will respect the employer who takes enough interest in his welfare to teach him the rudiments of safety, for he feels then that his employer is interested in his well-being and in the welfare of his family, who are dependent on him as a bread-earner. The idea of safety is too big to be limited to any one class or group—it belongs to all humanity, regardless of race, tongue, or color.

OAKLAND (CALIF.) TRADE SCHOOL ENCOURAGES KNOWLEDGE OF WELDING

The Central Trade School, which is a part of the public school system of Oakland, Calif., has a successful Welding Department containing five motor-generator sets and one alternating-current transformer for arc welding, also 17 outfits for the classes in gas welding. Classes are held every afternoon and on certain mornings and evenings in the week.

Only young men are encouraged to attend; adults, however, may enter the classes if they are employed at an occupation in which welding supplements the regular routine of work. These restrictions in enrollment result from the belief that the welding industry will profit most by obtaining young men who have gone through a preparatory period and then served a genuine supervised apprenticeship.

The school is now engaged in making a survey of welding activities in the Oakland territory with the aim in view of establishing some standards. A joint committee, consisting of three employers appointed by the chairman of the San Francisco Section of the American Welding Society, three members from the Oakland lodge of Associated Welders and Helpers, and one member from the Central Trade School, has framed and approved an apprenticeship-training agreement, which requires that the applicant sign up for a two-year apprenticeship after he has attained some proficiency in the school.

For four hours every afternoon a welding class of about 20 school students, ranging in age from 16 to 21 years, is in session. The Monday morning four-hour classes are given over to students under 18 years of age who have left school and are working but are required by the California Continuation Education Law to go to school for four hours each week. Each of these classes has about 25 students enrolled, these being employed in welding shops, machine shops, shipyards, foundries, etc.

On Tuesday and Friday mornings, a mixed group of adults and school students attend.

The trade extension group of employed adults attends for three hours on Monday and Wednesday evenings. In this class are 40 adults comprised of plumbers, machinists, blacksmiths, structural workers, boiler-makers, welders, etc. They are required to take at least 30 minutes of related-subject work in addition to their manipulative work. Two instructors are used for this group.

The system of teaching uses lesson sheets. Ten lesson sheets are prepared for arc welding and ten for gas welding, after which the student progresses through ten more lesson sheets of a more advanced nature, these last ten being the same for both arc and gas welding. Each lesson sheet, together with a specimen made by an experienced welder, is on display so the student may see his objective. Students are required to start with job No. 1 and take the jobs in rotation. They are not permitted to pass on to the next higher number until they become proficient on the preceding job. A careful check is recorded of their progress, both manipulative and technical.

LARGE WELDING SCHOOL IN BUFFALO

The rapid increase in the manufacture of aircraft, a good deal of which activity is concentrated in the district of Buffalo, N. Y., has given rise to quite a demand for aircraft welders in that neighborhood. The Elm Vocational School of Buffalo has for sometime been giving an extensive course of instruction in oxy-acetylene welding and have found that the demand for this instruction has increased tremendously during the past year. Accordingly, they have expanded their facilities so that they are now able to take care of about 200 students. The instructor, Mr. M. F. Doebert, states that it has been necessary to establish special courses for men who want to follow different trades in addition to a general welding course. So far, the special courses which have been worked out include a beginners course in aircraft welding, an advance course in aircraft welding and special course in pipe line welding. The unusually large enrollment is a testimony of the splendid work done by the school and also an indication of the rapid expansion of welding activities in the vicinity of Buffalo during recent years.

CARNEGIE TECH ENLARGES WELDING SCHOOL

The increasing interest in the technique and possibilities of welding has caused the Carnegie Institute of Technology to extend its facilities in this direction by the installation of new equipment, which now makes the welding school of this Pittsburgh institution one of the largest in the country and enables the handling of the largest classes in welding ever conducted anywhere. This is the fifth time that this department has been enlarged in the past ten years.

The classes at Carnegie, which are under the able direction of Prof. S. E. Dibble, consist of two groups, one to teach skill in welding, with the torch and electrode considered as tools, and the other to teach the young engineer the possibilities of welding in his chosen profession.

The night classes in welding have an enrollment of over 250 students. These are selected from a long list of applicants from the various metal trades in Pittsburgh. The night instruction

is aimed to perfect skill and to teach the student the underlying reasons for the fusion of metals, penetration, expansion and contraction, etc. In the day classes, which have an enrollment of over 350, special attention is given to structural, aeronautical, automotive, pipe, and container welding.

Ten booths are provided for these classes, each containing a control panel, rheostat, reactor, work table, head shield, electrode holder, and accessories, and actual welding is done in each booth. Two portable single-operator welding sets are available. A General Electric 1000-ampere set was added this year.

Gas welding is carried on with 16 modern torches conveniently piped from gas manifolds. Work tables, preheat muffles, and accessories are available for all welders.

FINANCE COMPANY ORGANIZED TO MAKE LOANS TO TRADE-SCHOOL STUDENTS

The Students Aviation & Trade Schools Finance Co. has been organized in San Diego, Calif., for the making of loans to students to cover tuition for aeronautical and trade-school training upon a basis within a reach of every adult or boy of good character and standing. The interest on the loan, together with the investigation fee, is no higher than that charged by reliable finance companies specializing on small loans. The loan can be repaid in small monthly installments beginning 30 to 60 days after graduation, thus allowing the student a reasonable time to secure employment before any payments mature.

J. Russell Jones, San Diego capitalist, and Robert Huntley, former registrar and secretary of Pacific Technical University, who are organizers of the new company, contemplate the establishment of a chain of similar companies throughout the country. Applications are considered for enrollment in any licensed aeronautical or recognized trade school or business college, and the company claims to make no charge for counsel and advice to applicants on matters affecting student problems.

This is a new departure in the field of commercial finance and the first organized effort to furnish assistance of this kind to young men whose financial condition has prevented the realization of their cherished ambitions.

"SCOLITE" WELDING RODS

The Kayness Company, 100 W. Monroe St., Chicago, has been formed for the purpose of manufacturing "Scolite" welding rods. Scolite welding rods are used in the welding of cast iron by the Electric Arc process, the welding rod being the *positive* electrode. It is the intention of the company to seek national distribution immediately and a suitable merchandising campaign is being planned.

The welding procedure closely resembles that of the oxy-acetylene process so far as the preparation of the parts to be welded are concerned, only a minimum amount of pre-heating is necessary in most cases. The weld deposit is said to have a close grained structure which has been shown by test to have a very high tensile strength. When applied under the most ordinary conditions the weld deposit is found to be easily machinable, without any trace of a graphitic line at the fusion point. The process is claimed to be advantageous from an economical standpoint due to the fact that it is possible to deposit from 12 to 20 pounds of weld metal per hour, depending on the size of the rod and the amperage used.

ELECTRECO A-C ARC WELDERS

Announcement has been received of the production of a new transformer type arc welding machine called the Electreco, manufactured by the Electric Equipment Company of Chicago, Illinois. The manufacturers state that this new machine is designed to meet the most severe tests of welding and to withstand the hard usage to which the machine may be put. The machine is enclosed in a steel box of 23" dimensions resting on 3½" ball bearing swivel casters. The manufacturers state that by proper adjustment of the nine point control switch, the machine may be used with any size wire from $\frac{1}{16}$" to $\frac{5}{32}$", giving a good weld and deep penetration. The nine points of adjustment range from 70 to 300 amperes. It is said that a distinctive feature of this new welder is the ease with which an arc may be drawn without loss of time due to sticking and that general characteristics of the transformer are simplicity of construction, good welding power and all around effectiveness. The equipment is supplied with two 20 foot lengths of heavy duty extra flexible welding cable, a supply of electrodes, electrode holder and a shield of either the hand or head type.

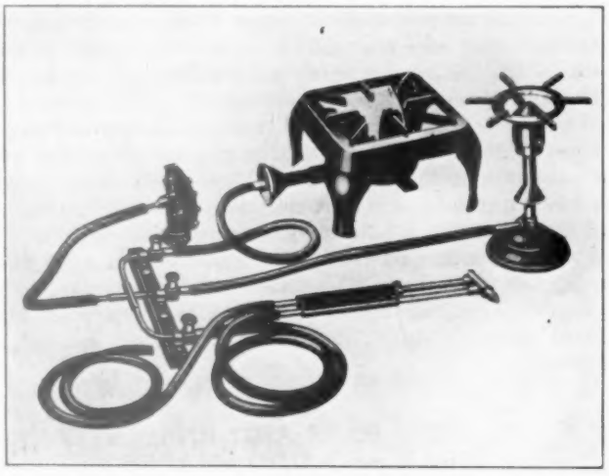
DEALER WANTS LINE OF RESISTANCE WELDERS

The Welding Engineering Company, 1032 Thirty-eighth St., Milwaukee, Wisconsin, have been looking for a line of spot, butt and seam welders to sell in the Milwaukee district. This company is already carrying a complete line of electric arc welding equipment and oxy-acetylene welding equipment and supplies and accessories for both processes. It is their desire to make their service more complete by taking on a line of resistance welding equipment.

A CONVENIENT SOURCE OF INTENSE HEAT FOR LABORATORY WORK

Plants maintaining testing laboratories of various sorts do a great deal of their experimental and research work with the aid of small flame apparatus.

The flame can be easily controlled and is hot enough to melt various metals. A most convenient and complete laboratory installation consists of a small tank of dissolved



Hot Plate, Bunsen Burner, and Torch That Burn Dissolved Acetylene Gas.

acetylene; a hot plate; a Bunsen burner; an acetylene-and-air torch with air control; a reducing valve; a three way branch valve, and the necessary red gum tubing.

With this outfit all manner of laboratory tests can be undertaken. Dissolved acetylene has many distinct advantages over liquid or other gas fuels. It not only produces a higher flame temperature than coal gas or natural gas, but forms a flame that can be perfectly controlled. This flame is non-oxidizing and non-carbonizing as well.

A special type of torch has been developed for test work and uses compressed air in addition to dissolved acetylene. The flame may be changed from the brush type to an intense needle point by adjusting the air supply. This accomplished by the simple twist of the adjusting screw. The brush, or bunsen flame, has a temperature of approximately 2,800 degrees Fahrenheit and the needle point flame produces

approximately 3,300 degrees Fahrenheit, making it suitable for any work requiring high temperature. A wide latitude of temperature control is possible by adjustment of the gas pressure, providing a range of heat in many metals, from near melting, to the molten stage.

The hot plate and bunsen burner recommend themselves by their convenience, cleanliness and intensity of the flame. They save time and keep instruments and utensils free from soot and smoke.

NEW ELECTRODES ADDED TO G-E LINE

A recently issued folder describing G-E welding electrodes lists three that are comparatively new, known as Types H, L, and M. Type H is a lightly coated solid-wire electrode, that is said to have a rapid rate of fusion with high currents and a strong, stable arc, assuring high speed in welding; it is recommended for the automatic work. The Type L electrode is a low-priced bare wire for general welding, but of high quality. Type M is for the general welding of steel where exceptionally sound and ductile welds are required; the slow fusion rate assures deep penetration. Like other G-E welding electrodes, these types are furnished in 50-lb. packages, securely burlapped, or in coils of approximately 100, 150, or 200 lb., or on reels of approximately 200 lb. A copy of the folder describing these types can be obtained from the General Electric Co., Merchandise Department, Bridgeport, Conn.

"TROXEIT"—A NEW SPOT-WELDING ELECTRODE MADE OF HARDENED COPPER

The Fansteel Products Co., Inc., North Chicago, Ill., has issued a folder describing "Troxeit", a new resistance welding electrode material made of copper hardened with tungsten. "Troxeit" electrodes are said to be of uniform high quality, both in analysis of the metal and precision of manufacture. The Fansteel company will also furnish "Troxeit" in the form of replaceable tips to fit electrode holders, or they will supply "Troxeit" metal in rods, bars, or shapes for those who wish to make their own tips or dies. This metal is easily ground, filed, or machined, it is claimed, yet requires little or no redressing. On the difficult operation of welding spokes in wire wheels, a pair of "Troxeit" electrodes made 6,240 welds to only 50 welds made by ordinary copper electrodes on the same job. The Fansteel company can also supply specially shaped electrodes of "Troxeit" metal to meet unusual requirements.

BENDING IRON BARS AND PIPE INTO REGULAR AND ODD SHAPES

An efficient bending machine for the making of shapes from bars and pipe is a saver of time and labor on many jobs that come into the welding shop. A device that will bend metal strips, bars, rods, pipe, and conduit, and is capable of a great many different adjustments, permitting the making of angles, offsets, eyes, rings, U-shapes, S-shapes, etc., has been put on the market by the Hossfeld Manufacturing Co., Winona, Minn. The making of small and difficult shapes is a simple matter with this machine.

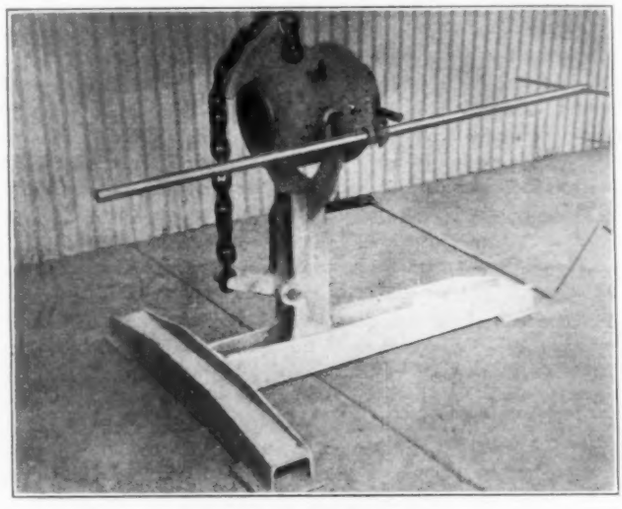
The Hossfeld Universal Iron Bender, "Wrenchless Type," consists of two yokes, connected at the open ends with a bolt, with other bolts fitted in the yokes themselves and capable of adjustment. A variety of bending dies is supplied, these fitting snugly over the bolts. One yoke is mounted stationary on the table or bench, while the other yoke is moved by hand. The work is so inserted into the bender that the movement of the hand-operated yoke bends the piece into the desired shape.

The mechanism of this bender is extremely simple, the large variety of shapes obtained being made possible by a wide selection of dies and a few simple attachments. The machine weights only 75 lb. and requires but little space. All parts that take the strain are made of finely tempered steel.

BIT HOLDER FOR OIL FIELD SHOPS

Welding shops which specialize in the rebuilding of oil field drilling tools will be interested in knowing that Stoody Company, Whittier, California, have perfected and placed upon the market a device which they have designated as the Stoody Universal Bit Holder.

With mechanical refinements seldom found in a similar type of equipment, this Stoody Universal Bit Holder will not only eliminate much of the labor incidental to the handling and moving about of oil field bits while they are being welded and ground, but



Stoody Universal Bit Holder.

will, as well, insure of the maximum in accuracy in the rebuilt tool. By using the device, it is claimed that the bit will be true to gauge and also true to the axis of rotation of the bit. This degree of accuracy is made possible by a calibrated gauge on the bit holder which reads directly in the bit diameter.

Another interesting feature of this new bit holder is the ease of adjustment for both rotation of the bit and movement in degree to the horizontal or vertical. The head of the device rotates on two rows of 15/16 inch hardened chrome-molybdenum steel balls and has a thumb screw for setting the tension on rotation as well as locking against any rotation. The degree to the horizontal is controlled by a screw which is operated by a long handled crank so that the operator need not leave his welding position when raising or lowering the end of the bit.

R. D. THOMAS HANDLING ARCOS ELECTRODES

R. D. Thomas and Company of Philadelphia and New York announce that they are now distributors for the new Arcos Electrodes. These electrodes have been developed in Belgium and are extensively and favorably known throughout Europe but have only recently been introduced in this country. Their principal use is for the arc welding of those metals and alloys which it has previously been difficult or impossible to weld by the arc process. The special metals which can be arc welded by the Arcos process include rustless and stainless steels, heat resistant alloys, brasses and bronzes, high manganese steels, aluminum and aluminum alloys and cast iron.

The Arcos Electrode consists of a metal core surrounded by a heavy coating which contains the proper metallic and non-metallic substances necessary to give a deposit of the desired analysis and physical properties. Thus, the electrode as a whole,

that is, the core plus the heavily impregnated coating, constitutes a balanced ration or charge which, when melted in the electric arc combines the constituents into the deposit metal.

Some of the non-metallic constituents of the electrode volitilize to form the wall of protective gases. Others form a slag which floats on top of the molten deposit and as the arc passes on, this slag freezes into a hard, glasslike, protective coating which slows down the rate of cooling of the deposit metal. This slow cooling allows the deposit metal to freeze under favorable conditions for good physical characteristics.

LOCKWOOD HILL TO HANDLE SALES OF "LINCOLN" WELDERS IN ST. LOUIS

The exclusive sale of the products of The Lincoln Electric Co. and of the Baker Industrial Truck Co. in the St. Louis metropolitan district and the eastern Missouri and southern Illinois

politan district and the eastern Missouri and southern Illinois territories has been placed into the hands of the Hill Equipment Engineering Co., with offices at 4620 Delmar Blvd., St. Louis, Mo. The Hill company, which was only recently organized by Lockwood Hill, for ten years a member of the Blackman Hill Co. of St. Louis, will carry a complete stock of "Stable-Arc" welders and "Line-Weld" motors, welding supplies, accessories, and parts. Mr. Hill is a graduate of Cornell University, class of 1909, and was a pioneer in the arc-welding field. He specialized in this line and sold the first arc welders in the St. Louis territory early in his business career.

ENGLISH FIRM STUDIES BIG WELDING FIELDS

The November issue of "The Welder", which is the second number of this magazine, published by Alloy Welding Processes Ltd., Ferry Lane Works, Forest Road, London, E. 17, England, is an attractive 5½x8½, 28-page periodical. One of the articles it contains discusses the design of welded joints in structural steelwork, gives a comparative analysis of the effect of the human element in the riveting and welding of joints, discusses both kinds of joints from a structural point of view, and describes the making of suitable welds. In an article entitled "Could the Railways Cut Working Costs by Welding?", appearing in this number, suggestions are made for effecting economies in the use of arc welding on certain details of the rolling stock, as well as for the making of repairs on bridges and other structural work.

BUSSMAN APPOINTED PRESIDENT OF STANDARD STEEL & WIRE

Amos G. Bussmann, formerly Welding Engineer for the American Steel & Wire Company, New York City, has resigned his position in that capacity to become President of the Standard Steel & Wire Company.

Prior to his last position, Mr. Bussmann was chief chemist at the Donora Steel Works and in this capacity was in close touch with the operative departments, such as, the blast furnaces, open hearths, blooming mills, rod mills, wire drawing and other finishing mills. This experience and his last official position have brought him into intimate contact with the manufacture, development and sale of welding wire products.

The Standard Steel & Wire Company are manufacturers of high grade Electric, Gas and Toncan Copper Molybdenum Iron Welding Wires, and will be able to furnish the general trade the proper grade of wire for each particular welding problem.

The geneal offices are located at First National Bank Bldg., Greensburg, Pa., and the plant at Bolivar, Pa.

SPECIFICATION SHEETS ON "LINCOLN" WELDERS

Six specification sheets covering as many different types of the "Stable-Arc" welder, 300-amp. N. E. M. A. rating, have just been issued by The Lincoln Electric Co., Dept. No. 27, Cleveland, Ohio. The stationary-platform and portable-truck types for either alternating or direct current are described in these circulars, as well as a gasoline-engine-driven unit, complete in itself, and a belt-driven unit. Descriptions are given of the features of these welders that are of particular interest to the operator, such as the double control of welding heats, and also those features that make for reduced maintenance cost.

"ARCOGRAPH" GIVES ELECTRODE WELDING DATA

Users of "A. W. P." welding electrodes will find of extreme interest and value a method of obtaining essential data on butt welds which consists of a stiff card, 9½x12½ in., backed by a circular board that can be rotated by pressing the finger against its saw-tooth edges, which extend beyond the right-hand side of the card. Positive and negative leads are shown running from a motor-generator set, pictured on the left-hand side of the card. The negative lead connects with the welding bench, on the top of which a "window" has been cut, exposing a diagram on the revolving board that shows the thickness of the plate, the details of preparation of the joint, and the number of runs. Twelve such diagrams are included, covering the usual types and sizes of butt welds found in practice, ranging from $\frac{3}{32}$-in. material with a close joint to 1-in. material beveled and run three times on each side. As the diagram corresponding to the particular job in hand is brought to this window, figures appear at other windows that are cut into the card, these giving the number of minutes required per foot of seam for the job under consideration, the length in feet of electrodes required per foot of seam for each run the corresponding amperes required, and the gage o the electrodes. This novelty card, known as the "Arcograph", is put out by the Alloy Welding Processes Ltd., Ferry Lane Works, Forest Road, Walthamstow, London, E. 17, England.

NEW FOLDER ON WELDING WIRE

Interesting views showing applications of "Roebling" welding wire in both gas and electric welding of different types of structures, as well as in the welding of glass-lined milk tanks, are shown in a new folder issued by the John A. Roebling's Sons Co., Trenton, N. J. Among the applications shown is the welding of a section of the Detroit-Windsor vehicular tunnel, which was described in the October issue of *The Welding Engineer*.

"GAS LITERS" DESCRIBED IN NEW CIRCULARS

The "Matchless Movable File Gas Liter," the "Larsen Round File Gas Liter", and "Larsen's Shoot-a-Lite Safety Gas Liter" are shown and described in new literature recently published by the Matchless Utilities Co., 690 Eighth Ave., New York, N. Y. A circular issued by the same company also describes the "Capitol" cigar lighter and ash tray. The popularity of the "Movable File Gas Lighter" among welders is indicated by the statement that one large welding-equipment manufacturer is distributing 150,000 of them a year.

NEWS OF THE INDUSTRY

Contractor McGonigle in charge of the steel work on the nine-story Eastern Building being erected in Portland, Ore., is having the entire steel framing welded instead of bolted. This is said to be the first job of its size to be entirely welded in Portland, and it is being closely watched by steel men.

A report from Longview, Wash., states that a remodeled combination arc welder and air compressor that is unique in several respects has been completed by W. C. Cheney, who operates a shop in that city.

A meeting of the Tri-City Plumbing and Heating Trade Deveolpment League was held at the Blackhawk Hotel, Davenport, Iowa, December 4th. Dinner was served to 60 members, after which an address was given by I. D. Greene, of the Modern Engineering Co., Davenport, Iowa, on "The Development of Welding in the Plumbing and Heating Industries." Announcement was made that the annual dinner-dance of the League would be held in February.

The Australian Welding Institute held their regular monthly meeting in the main lecture room of the Working Men's College, Latrobe St., Melbourne, Australia, on the evening of November 28th. C. O'Malley gave a lecture on "Some Applications of Welding in Bridge Work," illustrated with lantern slides.

The Linde Air Products Co. announces the opening of an oxygen plant at 60 Knott St., Portland, Ore. This plant, which started operations on November 19th, 1919, is located on a private siding on the Oregon Washington Railroad. A. D. Davis is superintendent of the Portland Linde plant and D. F. Fox, whose headquarters are at 114 Sansome St., San Francisco, Calif., is district superintendent. R. W. Daggett is division superintendent with headquarters also at 114 Sansome St., San Francisco, Calif.

The Carbo-Oxygen Co. has joined The Gas Products Association. This company has plants at Chicago, Pittsburgh and Cleveland.

A. A. Heller, of the International Oxygen Co., Newark, N. J., has just returned from a trip to Russia.

The Lincoln Electric Co., Cleveland, Ohio, announces that R. B. Tuhey has been advanced to district representative at Indianapolis, Ind., with offices at 517 Peoples Bank Bldg., and that S. H. Taylor has been promoted to the position of district representative at Los Angeles, Calif., with headquarters at 812 Mateo St.

Alexander F. Jenkins, of the Alexander Milburn Co., Baltimore, Md., who has been on an extended trip through the Near East, Egypt, and other parts of the world, is expected home at about Christmas.

The Smith Welding Equipment Corp. has become a member of The Gas Products Association.

The Mid-Winter Convention of The Gas Products Association will be held at the Lake Shore Athletic Club, Chicago, January 20, 21, and 22, 1930, instead of January 22, 23, and 24, as originally planned. O. E. Engler, of The Balbach Co., Omaha, Nebr., is president.

The Chase Brass & Copper Co., Waterbury, Conn., has opened a branch office and warehouse at 340 East Water St., Milwaukee, Wis. C. W. Baker, formerly of Chicago, is in charge.

The John Evans Welding Co., Sumter, S. C., is planning the immediate rebuilding of their plant, which was recently destroyed by fire.

The Scott Welded Products, Inc., Van Alst and Harris Aves., Long Island City, N. Y., is having built a one-story addition to their plant, to cost about $30,000 with equipment.

The Reid-Avery Co., Inc., Philadelphia, Pa., has appointed the Harry G. Masten Co., 105 W. Monroe St., Chicago, Ill., as representative for the sale of "Raco" welding wire.

The Detroit Vehicular Tunnel is the subject of a photograph in a blotter issued to the trade by the John A. Roebling's Sons Co., Trenton, N. J.

The Commercial Acetylene Supply Co. plant at Blue Island, Ill., serving Chicago and surrounding territory, is again enlarging its cylinder-charging capacity by erecting additional charging racks or connections.

The Stiteley & Nelson Welding Co. is a new Detroit, Mich., firm organized by B. H. Stiteley and R. G. Nelson to conduct a general job welding business. The firm's address is 553 Milwaukee E. Mr. Stiteley was formerly with the Hudson Motor Car Co. for nine years, and Mr. Nelson was for twelve or thirteen years in the welding trade, and was connected at one time with the Welded Products Co., of Detroit.

L. H. Christensen has been appointed welding engineer of the Reid-Avery Co., of Philadelphia.

Charles P. Clampitt has been appointed manager of the Chicago, Ill., office of The Alexander Milburn Co., Baltimore The Chicago office address is 220 S. State St. Mr. Clampitt has had many years of experience in the welding industry in the Chicago territory.

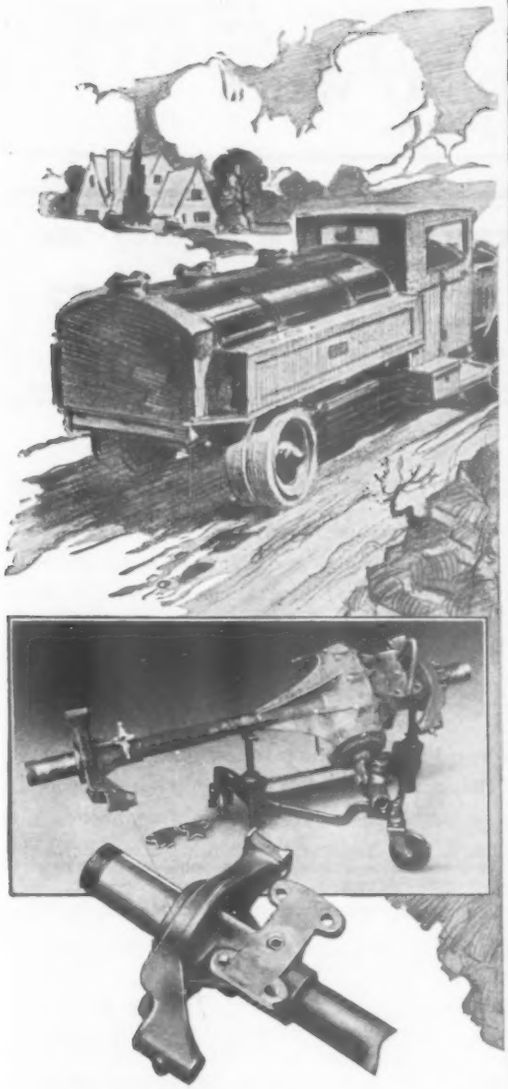
Arcos, Inc., has appointed F. J. Giroux, 488 Ella St., Wilkkinsburg, Pa., as manager of the company in the United States. The following jobbers have also been appointed: R. D. Thomas & Co., Philadelphia, Pa.; The Weld Craft Equipment Co., Pittsburgh, Pa.; and The Corby Supply Co., St. Louis, Mo. The Arcos, Inc., plant is at La Crosse, Wis.

Maurath, Inc., have moved their Cleveland, Ohio, plant from East 18th St. to 3139 Croton Ave., where they have installed additional production equipment to take care of the increasing demand of alloy welding rod in the chrome-nickel range.

Compressed Industrial Gases, Inc., through its subsidiary, the Burdett Oxygen & Hydrogen Co. of Chicago, has completed erection and installation of an acetylene plant at Summit, Ill., an industrial suburb of Chicago. The new plant represents an investment of $100,000 and will begin operation about January 1, 1930.

The Philfuels Co. are now conducting all their operations from their new offices at 7-101 General Motors Bldg., Detroit, Mich. The various activities of the company are now centralized at the Detroit office, which will result in increased coordination between departments as well as certain economies. The executive offices, engineering and construction departments, and other departments formerly located at Bartlesville, Okla., have also been concentrated at the Detroit office.

The Stuart Oxygen Co., San Francisco, Calif., is now marketing oxygen and acetylene as well as Rego apparatus in the Los Angeles, Calif., territory.



The broken spring saddle before and after repair-welding with Tobin Bronze.

Broken motor truck part *quickly* repair-welded with

TOBIN BRONZE

Trade-mark Reg. U. S. Pat. Off.

A BROKEN spring saddle on the drive shaft of this oil truck was repair-welded with Tobin Bronze and restored to service in less than two hours .... one hour for preparing the broken pieces and 45 minutes for the actual welding. 32 feet of oxygen, 32 feet of acetylene and 2½ pounds of Tobin Bronze filler rod were used. Pre-heating was unnecessary, as Tobin Bronze flows freely at 1650° F.

Incidentally, it would be difficult to devise a more severe test of a welding material, as the spring equipment of a tank truck is subjected to unusually punishing service due to constant shifting of the load. The strength and toughness of Tobin Bronze are so well known that, for years, welders have been using this material for jobs where high strength is required.

The uniform composition and high quality of Anaconda Copper Alloy Welding Rods are due to the experience and technical knowledge of The American Brass Company in developing a complete line of rods for welding iron, steel, copper and copper alloys. Publication B-13 contains complete information on all Anaconda Welding Rods. We will gladly mail it, free of charge, on your request.

THE AMERICAN BRASS COMPANY

General Offices: Waterbury, Connecticut
Offices and Agencies in Principal Cities

ANACONDA

WELDING RODS

ANACONDA
from mine to consumer

There is a suitable Anaconda Filler Rod for every welding purpose. The principal Anaconda Welding Rods, with their melting points, are listed below:

for oxy-acetylene welding

Tobin Bronze*	1625°F
Manganese Bronze	1598°F
Brazing Metal	1634°F
Naval Bronze	1625°F
Electrolytic Copper	1981°F
Silicon Copper	1981°F
Phosphor Bronze	1922°F
Everdur*	1866°F

for arc welding

Silicon Copper	1981°F
Phosphor Bronze	1922°F
Everdur*	1866°F

*Reg. U. S. Pat. Off.

PHILADELPHIA, PA.
Gas and Electric Welding Wire

EDGCOMB STEEL
Distributing for
AMERICAN STEEL & WIRE CO.

NEWARK, N. J.
A Type for Every Purpose

PREMIER TESTED WELDING WIRE
Complete Stocks for Immediate Delivery

TISCO

MANGANESE STEEL WELDING WIRE $\frac{1}{8}$" to $\frac{5}{16}$" dia.
STOCK SHIPMENTS

The premier rod for the repair, or building up of worn Manganese Steel Track-work and other castings requiring a hard tough surface. Manufactured by the makers of Tisco Manganese Steel; the first in America to produce this remarkable metal.

WM. WHARTON JR. & CO. INC. EASTON, PA.
TAYLOR-WHARTON IRON & STEEL CO. HIGH BRIDGE, N. J.

Classified Ads

Help Wanted—75c per line, minimum 4 line
Jobs Wanted—4 lines free.
Other Ads—$1.00 per line, minimum 4 lines.
Counted 8 words to line. Add 6 words for keyed address.

Position Wanted—Welder with nine years experience in both electric and acetylene welding in foreign countries and in the United States wishes employment with steady work. Will give references and will move to any part of the country. Address Box 220, care of The Welding Engineer.

Wanted—Welder to go into business for himself in well equipped welding department in established automotive machine shop. Address Motor Craft Corporation, 243 Plane St., Newark, N. J.

Position Wanted—Experienced Millwright and welder looking for steady employment. Is single and can therefore go to any part of the country. Address Box 221, care of The Welding Engineer.

Welder with five years of experience in many kinds of welding work is desirous of establishing himself in the welding supply business. Can give references. Address Box 222, care of The Welding Engineer.

Position Wanted—Welder and general mechanic with experience in aircraft, sheet metal, and commercial welding wants work and is able to start at once. Willing to leave town. Address Mr. S. Ludwig, 2601 Burd Ave., St. Louis, Mo.

Position Wanted—Electric arc welder, graduate G. E. Arc Welding School, ten years' experience, seeks connection with permanent employment. Preferably where there is only one welder. Married. Address Box 466, Matamoras, Pa.

WANTED
WELDING EQUIPMENT AND SUPPLY SALESMEN

To handle a side line specialty which will not conflict. Replies will be treated in confidence. Our employes know of this advertisement. Address Box 215, care of The Welding Engineer.

Salesman Wanted—Manufacturer of motor generator type, electric arc welding apparatus has some territories open for live agents on profitable basis. Write fully in confidence, giving age, experience, etc. Address Box 216, care of The Welding Engineer.

Wanted—Experienced Oxy-Acetylene Welder, all metals. Repair all makes of torches, regulators; only thorough mechanic having had some bench assembly and machine shop experience. Write fully, age, education. Burner Service Station, 1718 Sansom St., Philadelphia.

REBUILT WELDERS
ARC WELDERS SPOT WELDERS
We buy, sell and exchange.
We are also factory representatives on new machines.
GOODMAN ELECTRIC MACHINERY CO.,
126 Green St., Newark, N. J.

Everlight Gas Lighter

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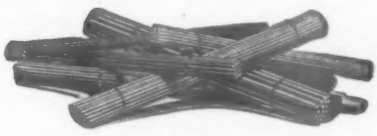

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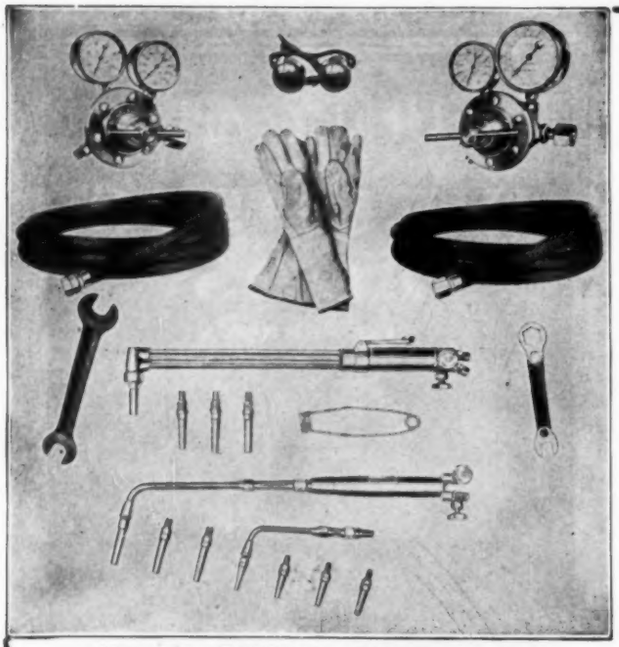

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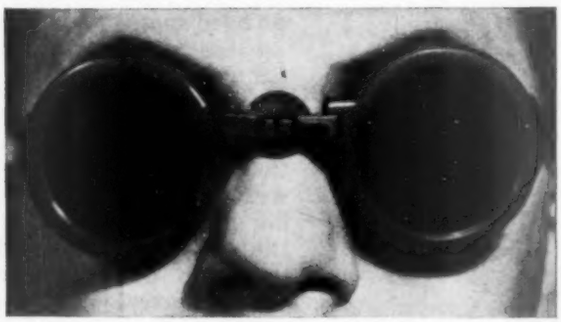

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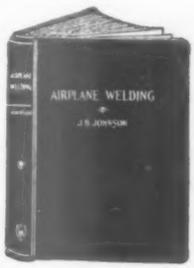

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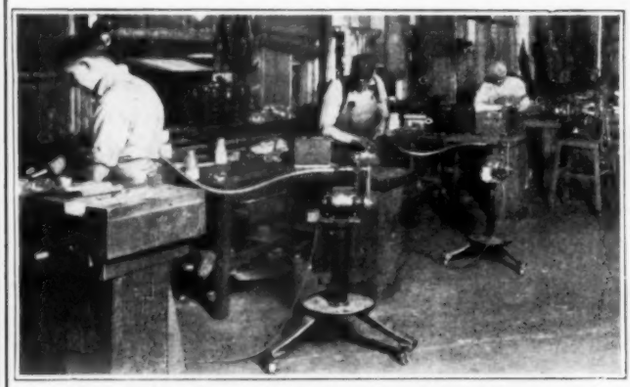

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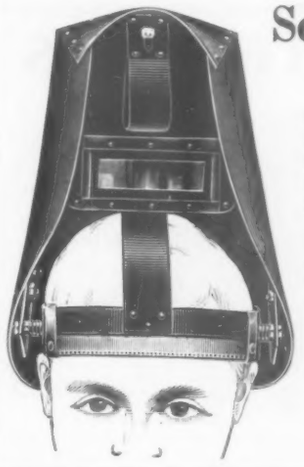

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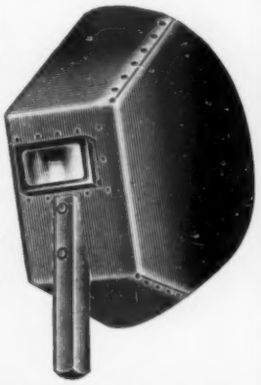

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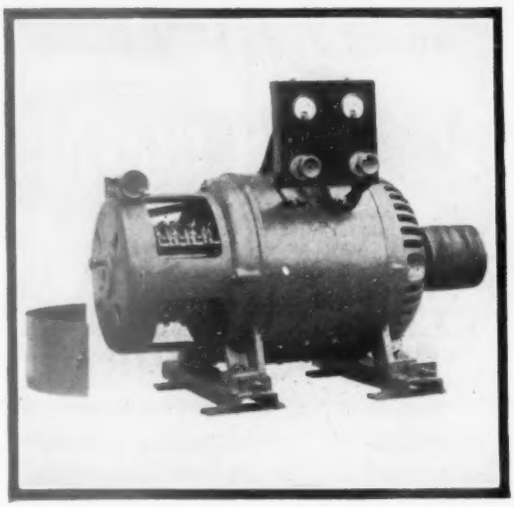

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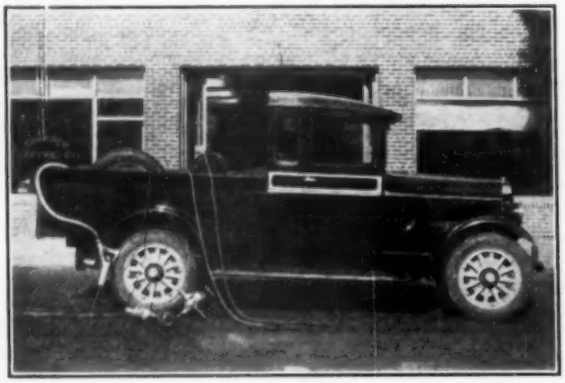

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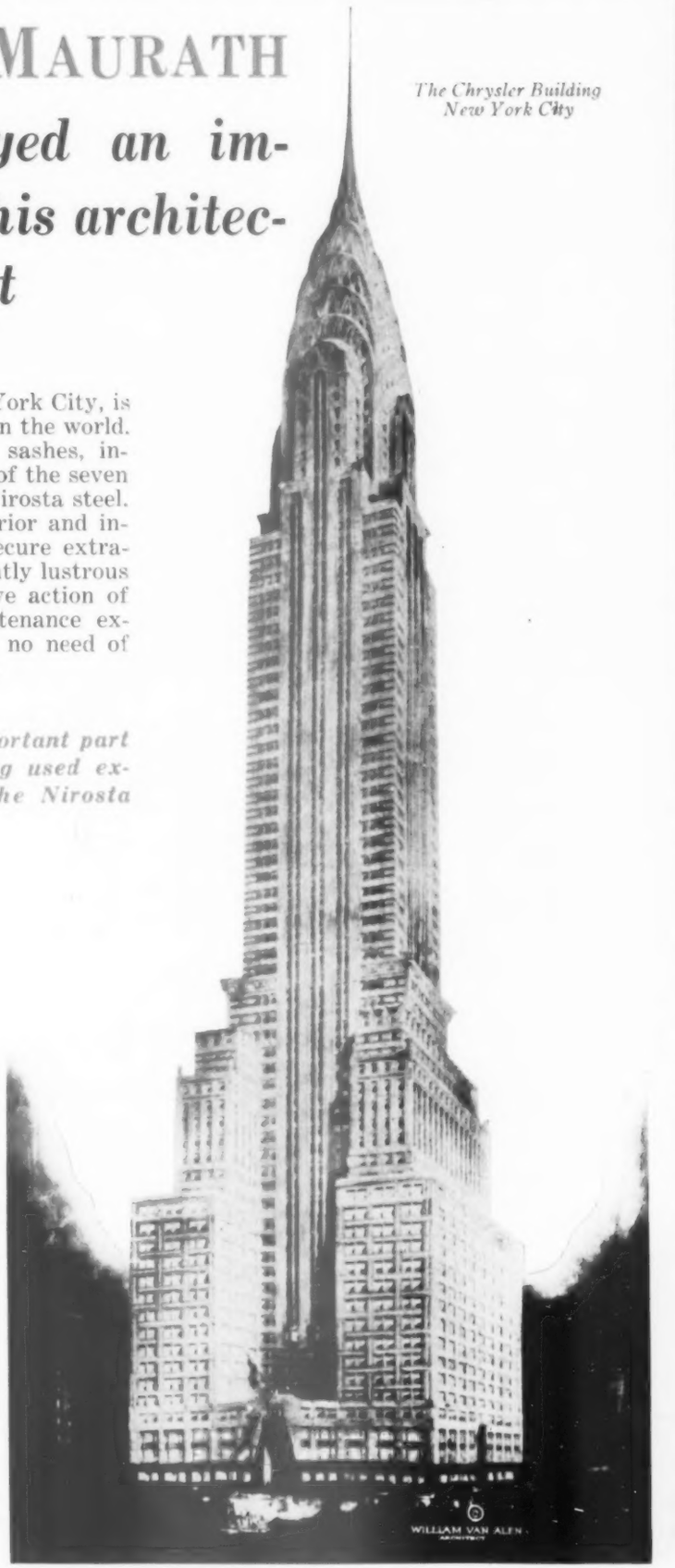

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